Government of India
Ministry of Chemicals & Fertilizers
Department of Chemicals & Petrochemicals

# 5th NATIONAL AWARDS

# TECHNOLOGY INNOVATION in Petrochemicals & Downstream Plastics Processing Industry 2014-15

Saturday, February 21, 2015

The Lalit Ashok, Bengaluru

**Shri Ananth Kumar**
Hon'ble Minister for Chemicals and Fertilizers,
Government of India
New Delhi - 110 001

I am happy to learn that the Department of Chemicals and Petrochemicals, in association with Central Institute of Plastics Engineering & Technology (CIPET), is organizing the Presentation of **"5th National Awards for Technology Innovation in Petrochemicals and Downstream Plastics Processing Industry"** on February 21, 2015 at Bengaluru. The Petrochemicals sector is a key sector of the global and Indian economy, and Petrochemicals & Downstream Plastics Processing Industries in India have been playing a predominant rote in shaping growth of our economy.

The National Awards for Technology Innovation have been designed with a view to encourage the stakeholders of this Industry to constantly innovate and move with the time to meet the stakeholders of this Industry to constantly innovate and move with the time to meet the fast changing requirements of Petrochemicals Industry. Research & Development play a critical role in the innovation process which sustains growth and enables the industry to remain competitive so as to meet the global challenges. I believe that the presentation of these awards not only encourage the petrochemical and downstream plastic industries to strive for innovation, excellence and improvement of services delivered but also position their products in the global market.

I wish all the success to the award winners and look forward to a higher level of participation in the forthcoming editions of the National Awards for Technology Innovation in the field of petrochemicals and downstream plastics processing Industries.

**( ANANTH KUMAR )**

**Shri Hansraj Gangaram Ahir**
Hon'ble Minister of State for Chemicals and Fertilizers,
Government of India
New Delhi - 110 001

The Department of Chemicals & Petrochemicals has taken initiative to facilitate the growth of the Plastic industry by incentivizing innovation & promoting the R & D in the field of polymer through the National Awards for Technology Innovation in Petrochemicals and Downstream Plastics Processing industry.

I am happy to note that the National Award scheme devised by the Department of Chemicals and Petrochemicals has successfully completed four consecutive editions and the presentation of National to the awardees in fifth edition has been scheduled on February 21, 2015 at Bangalore.

The contribution towards the development of newer technologies in the field of polymers are to be encouraged and hope that the National Awards scheme would inspire and motive the young innovators, scientist and professionals to endeavor to excel continuously in the vibrant field of innovation.

My hearty congratulations to all the awardees, I wish them all the best in their pursuit of excellence and hope that there innovation, enthusiasm and dedication will inspire other to work for constant innovations.

**( HANSRAJ GANGARAM AHIR )**

**Shri Surjit K. Chaudhary, I.A.S**
Secretary to the Govt. of India
Department of Chemicals & Petrochemicals
Ministry of Chemicals & Fertilizers
Shastri Bhavan
New Delhi - 110 001

I am delighted to know that my Department in association with Central Institute of Plastics Engineering & Technology (CIPET), is holding the Presentation of "5th National Awards for Technology Innovation in Petrochemicals and Downstream Plastics Processing Industry" on February 21, 2015 at Bengaluru.

The National Awards for Technology Innovation has been designed with a view to encourage the stakeholders of this industry to constantly innovate and move with the time to meet the fast changing requirements of Petrochemical Industry. The National Awards for Technology Innovation provides an opportunity to appreciate the innovation and innovator's contribution in socio-economic development of the country.

I believe that innovation using green technologies is the way forward for sustainable growth and realization of true potential of the industry where development will also take into account the environmental concerns. The innovative Research & Development in the areas of Petrochemicals will improve the efficiency of the existing products and technology.

I wish to congratulate all the awardees of 5th National Award for Technology innovation in Petrochemical & Downstream Plastics Processing Industry. I hop that the industry and the entrepreneurs shall continue with the good work of technology innovation and we shall see a healthy growth in the culture of innovation in the years to come.

**( SURJIT K. CHAUDHARY )**

**Shri Rajiv Yadav, I.A.S**
Special Secretary & Financial Adviser
Ministry of Chemicals & Fertilizers
Shastri Bhavan
New Delhi - 110 001

Department of Chemicals & Petrochemicals has formulated the Scheme of National Awards for Technology Innovation in order to promote Research & Development in Petrochemicals and Downstream Plastics Processing Industry. It is encouraging to note that the scheme has received great response from the industry, institutions and Individuals in the fifth year of its implementation.

I am happy to note that a function is being organised to felicitate the awardees of the 5th National Awards on 21st February, 2015.

My heartiest congratulations to all the awardees. I thank the members of the Expert committee who worked tirelessly during the process of selection. Central Institute of Plastics Engineering & Technology deserves congratulations for their untiring efforts in this regard.

12/2/15

**( RAJIV YADAV )**

**Shri Avinash Joshi, I.A.S**
Joint Secretary
Department of Chemicals & Petrochemicals
Ministry of Chemicals & Fertilizers
Shastri Bhavan
New Delhi - 110 001

Government of India has instituted National Awards for rewarding outstanding professionals in the field of Petrochemicals & Downstream plastics processing industries to create new avenues of development.

Accordingly, the department has successfully implemented the scheme through Central Institute of Plastic Engineering & Technology (CIPET) since its launch in 2010-11. Within the four years of introduction, the National Awards for Technology Innovation have achieved iconic stature among professionals and researchers from various industries and R & D Institutions.

The Fifth National Awards for Technology Innovation will also certainly bring out the most outstanding usage of technology to achieve in their persuit of excellence in performance through innovation in the various fields of Petrochemicals. I congratulate the Central Institute of Plastics Engineering & Technology (CIPET) for completing the 2014-15 edition of the National Awards for Technology Innovation as scheduled.

I wish the awardees all the best in their of excellence and hope that they will continue with their endeavour to contribute more to this segment through innovation.

**( AVINASH JOSHI )**

# Awardees

Dr. C. P. Reghunadhan Nair

Dr. V. Lakshmana Rao

Shri Suraj S

Shri Ranajit Pal

**Dr C. P. Reghunadhan Nair** obtained his Masters Degree in Applied Chemistry from Cochin University of Science and Technology, India in 1979 and PhD in Physical Chemistry of Macromolecular Materials from Louis Pasteur University of Strasbourg, France in 1989. He was a French Government Fellow during 1985-89 and was visiting scientist in CNRS, France in 1993. He joined Vikram Sarabhai Space Centre (ISRO), Trivandrum in 1980 and currently he is Scientist H and Group Director, PSCG at VSSC, and is working in the area of polymer and propellant materials for space applications. He is the recipient of Prof Sukumar Maity Polymer Foundation Award and Prof Santappa Silver jubilee Award for outstanding contributions to polymer science. He has guided 12 PhD students, authored more than 250 publications, 16 popular science articles, inventor in 20 patents. He has authored 2 books and 15 book chapters and reviews. Apart from contributing to the basic understanding in fundamental polymer science in the field of free radical polymerization, chain transfer, addition-fragmentation etc, Dr. Nair is much known for introducing the concept of INIFERTER, that led to development of a method for synthesizing end-functional and multiblock copolymers by free radical route.

**Dr. V. Lakshmana Rao** obtained his Masters Degree in Chemistry from University of Roorkee, India in 1980 and PhD on copolymerization of organic monomers with vinyl silanes from Indian Institute of Technology, Mumbai in 1984. He was a postdoctoral fellow during 1986 to 87 in Ehime University, Matsuyama, Japan. He joined Vikram Sarabhai Space Centre (ISRO), Trivandrum in 1987 and currently he is Scientist G and Head, PSCD at VSSC. He has guided 3 PhD and 6 M. Tech. students, authored 45 international journals, 2 review articles, 2 book chapters and inventor in 6 patents. His recent research field is in the area of engineering thermoplastics, thermoplastic toughened epoxy matrix resin for composites, polymer nanocomposites and matrix resins and fibre reinforced composites for space applications

**Shri Suraj S.** obtained his M. Sc. in Applied Chemistry and M. Phil. in Synthetic organic chemistry from Cochin University of Science and Technology, India in 1993 and 1995 respectively. He joined Vikram Sarabhai Space Centre (ISRO), Trivandrum in 1995 and currently he is a scientist SF and Head, Adhesives and Advanced Matrix Resin Section of Polymers and Special Chemicals Division at VSSC. He is inventor in 3 patents, guided 6 M. Tech, 10 B. Tech and 5 M. Sc students, authored 2 international journals and 30 national/international conference papers. Currently, he is working in the area of polymeric adhesive systems, matrix resins for composite, honeycomb structures and composites, radiation stable polymeric composites, nano materials, etc.

**Shri Ranajit Pal** obtained his Masters Degree in Chemistry from Indian Institute of Technology, Mumbai in 2006 and joined ISRO in 2008. Currently he is Scientist SD in Polymers and Special Chemicals Division of Vikram Sarabhai Space Centre, Indian Space Research Organization, Trivandrum. He is the inventor of 3 patents, authored one journal and 8 conference papers. He has guided 2 M. Tech., 3 M. Sc. Tech., 2 B. Tech. and one M. Sc. project students. Presently, he is working in the area of high performance polymeric adhesive systems, synthetic organic chemistry, study of nano materials and photo cross-linking polymers for space applications.

**Vikram Sarabhai Space Centre,**
**Indian Space Research Organization (ISRO)**
**Trivandrum**

## INNOVATION IN POLYMERIC MATERIAL

"Heat curable epoxy film Adhesive composition with filleting Characteristics for Space application"

**Dr. C.P.Reghunadhan Nair, Dr. V. Lakshmana Rao, Shri Suraj S & Shri Ranajit Pal**

Polymeric adhesives have great relevance to fabricate light-weight structures for aerospace applications. Bonding is the technique employed to fabricate sandwich panels of high specific strength. The popular core to make sandwich structure is honeycomb (made of aluminium or polymeric composite) and is bonded with face sheets of similar materials. To assemble core and face sheets together, a thermosetting adhesive film is required, facilitating the bonding maneuver with regulated glue line thickness. This also minimizes wastage of adhesive and accumulation of dead weight. Establishing an in-house technology to develop film adhesive is an important "chemistry and technology" milestone in Indian Space Research Organization (ISRO) and in the country as a whole. Chemistry includes the synthesis of high temperature stable polymeric resin which has the desired level of film forming characteristics. A key feature of film adhesive is the filleting property which is the capillary rise of molten adhesive along the honeycomb wall during cure and is achieved by polymer chain modification. The technological challenges of film adhesive are to enable the system to a space qualified product.

This Innovation entitled **"Heat Curable Epoxy Film Adhesive Composition with Filleting Characteristics for Space Application"** deals with the development and successful use of film adhesive in the fabrication of multi satellite adaptor (MSA) for PSLV C20 that initiated a new era in the indigenization of film adhesive in the country. The scope of film adhesive could be expanded to fabricate light-weight structures for industries like naval and wind energy.



**Team - Shri. Ranajit Pal,Shri. Suraj S ,Dr. V. Lakshmanarao & Dr. C.P.Regunadhan Nair is the JOINT WINNER of National Awards 2014-15 under the Category of "Innovation in Polymeric Material"**

**Dr. Lalit Varshney**

**Dr. Amar Kumar**

**Dr. Lalit Varshney** joined Isotope Division, Bhabha Atomic Research Centre in 1982 after completing 25th batch training school of BARC. He obtained Masters in Science (Chemistry) degree from University of Delhi and Ph.D from Mumbai University. He is presently, Head Radiation Technology Development Division of Radiochemistry and Isotope Group, Prof. Homi Bhabha National Institute, Mumbai. Dr. Varshney is currently engaged in the development of advanced materials for medical and environmental applications using Radiation technology. Dr. Varshney has about 70 publications, 3 patents and 4 technology transfers to his credit and a recognized expert of International Atomic Energy Agency on radiation processing applications. Dr Varshney is recipient of prestigious Indian Nuclear Society award 2004 and BARC Technical Excellence award-2003.

**Dr. Amar Kumar** joined Waste Management Division, Bhabha Atomic Research Centre in 1988 after completing 31st batch training school of BARC. He obtained Masters in Science (Chemistry) degree from Mithila University, Darbhanga, Bihar and Ph.D from Mumbai University. He is presently Scientific Officer (G) in the Institute and engaged in development of various materials and methodologies for nuclear waste management. Dr. Kumar has about 50 publications and 1 patent.

India has an ambitious Nuclear Energy program for contributing power to National Grid by harnessing condensed energy of Uranium. During the fission of Uranium atoms in fuel rods of a Nuclear Reactor, large amount of energy is released which is used for power generation. Besides energy, other nuclear fission products are formed, some of which are radioactive. These radioactive elements constitute nuclear waste which has to be managed for safer storage or use.

**Bhabha Atomic Research Centre**
Radiochemistry and Isotope Group, Mumbai

## INNOVATION IN POLYMERIC MATERIAL

Advanced Polymer Composite for Cesium Extraction from Nuclear waste/Non-Nuclear waste"

**Dr. Lalit Varshney & Dr. Amar Kumar**

In the present innovation, a polymer composite of polyethersulfone and Ammonium Molybdophosphate (AMP) was engineered to have properties conducive for separation of Gamma radiation emitting isotope Cesium-137 from the highly acidic nuclear waste in a simple and economic process. AMP is Cesium specific inorganic ion exchanger and the developed polymer composite allows its use in column operation in high radiation field under highly acidic conditions. The separated Cesium on the polymer composite can be directly compressed to form source pellets used in radiation source pencils. The Cesium radiation sources can be used for treatment of cancer, radiation sterilization of medical products, food preservation, sewage sludge hygienisation etc. The innovation is useful for Nuclear industry and other industries using inactive Cesium. Materials for similar nuclear use are not available from foreign sources.



Team - Dr. Lalit Varshney & Dr. Amar Kumar is the JOINT WINNER of National Awards 2014-15 under the Category of "Innovation in Polymeric Material"

**Shri V.K.Singh**

**Newgen Specialty Plastics Ltd,** incorporated in the year 2006, is a leading manufacturer of Specialty Masterbatches, Compounds and Rotomolded products in the country. It is the only integrated company in the country to have Compounding, Tooling, Moulding, Designing and Research facility under one roof and capable to develop new products at shortest lead time. Over a period of time it has developed many specialty compounds and products for the first time in the country, such as cellular PE and PP compound for Telecommunication cable, Antirodent Masterbatches, Foam compound for rotomolding, Grafted Polymer compounds, Pipe coating compound, XLPE Rotomoulding compounds etc. To-day Newgen is the fastest growing Rotomoulding Company in the world and aims to become No.1 company in its segment in the world. It's rotomolded product includes plastic pallets, insulated box, chemical tanks, plastic floats, OEM products etc. Newgen is supplying its product to big corporates of the country, various Government organizations, PSUs, besides export to Singapore, Australia, Malaysia, Middle East and Africa etc.

**Shri V. K. Singh** promoter & CMD of the company has done his M.Tech in Polymer Sc. & Technology from IIT, Delhi and has rich experience of more than 17 years with leading petrochemical companies like IPCL and GAIL. He has represented plastic industry at many national and international forums. He believes in Solution Through Innovation and Newgen has got many patent and rewards for breakthrough research works done under his guidance.

**Newgen** took this challenge and successfully developed this compound indigenously and to-day only producer of this compound in the country. The products made have Excellent chemical Resistance- it can be used to store strong acids, alkalis and oxidizers; Excellent Impact Strength- virtually unbreakable; Excellent Abrasion Resistance and very high HDT & VSP compared to standard PE compounds. This compound can be used to make strong and durable products such as chemical resistance tanks, Diesel tanks, Septic tanks, Floats, Automotive components and other industrial products. Newgen has not only developed the compound but also successfully commercialized many products for domestic as well as export market with this material by substituting conventional material more economically, safely and ecofriendly way.

Newgen Specialty Plastics Ltd.
Solution Through Innovation

## INNOVATION IN POLYMERIC MATERIAL

"Cross linkable PE Compound for Rotomolding"

**M/s Newgen Specialty Plastics Ltd.,**

Greater Noida

Plastic tanks have replaced almost all the conventional water tanks in the country, however, chemicals are still mostly stored in conventional tanks like MS tanks, FRP tanks etc. These tanks have limited life and require to change the inner lining at regular intervals. Industry also uses normal rotomolded tanks of higher thickness but that also has short life, because Rotomolded tanks are commonly made with MDPE/LLDPE and in special cases with HDPE. The MDPE has moderate mechanical and chemical resistance but poor rigidity. On the other hand HDPE has better rigidity but poor impact strength and chemical resistance. The chemical resistance of MDPE and HDPE are limited and it cannot be used for storing strong acids and alkalis. So, making large tanks or products with High rigidity, high chemical resistance and high impact strength is a great challenge. Crosslinked HDPE meets all the challenges but making Crosslinkable HDPE is challenge in itself.

Dr. Sandip Ghosh

Dr. Gupta

Dr. Isha kamrupi

**The Reliance Group,** founded by Dhirubhai H. Ambani (1932-2002), is India's largest private sector enterprise with businesses in the energy and materials value chain, and having annual revenues in excess of US$ 67 billion. The flagship company, Reliance Industries Limited, is a Fortune Global 500 Company and enjoys global leadership in its key product lines. RIL's Jamnagar refinery complex has the world's largest refining capacity at a single location and has an impeccable track record of safe and reliable operations. RIL is continuing its efforts to be a creator of intellectual property and is driving a "technology transformation" agenda that promotes scientific and technical excellence by fostering an eco-system for creativity and innovation.

**Dr. Virendrakumar Gupta** R&D Head, Polymer completed Ph.D in Chemistry from Banaras Hindu University in 1984. He has 110 patent applications, 60 publications in international peer reviewed journals, 5 book chapters, 50 invited talk presentations and conference presentations to his credits. He is awarded with Rashtriya Ratna and Vasvik award for outstanding achievement in Science & Technology in addition to National Technology, Indian Chemical Council, FICCI, Indira Innovation and Golden Peacock in the area of polyolefins at RIL.

**Dr. Sandip Ghosh** completed his Ph.D. in Polymer Chemistry from School of Chemistry, Hyderabad Central University. He has 7 publications in international peer reviewed journals and 2 patent applications.

**Dr. Isha Kamrupi** completed his Ph.D. in Polymer Science from the department of chemistry, Tezpur University. He has 12 publications in international peer reviewed journals and 1 patent application.

Reliance Industries Limited

**M/s Reliance Industries Limited, Mumbai**

## INNOVATION IN POLYMERIC MATERIAL

"Development of Eco-friendly Sulfur based Polymeric Material for Concrete Application using Refinery produced Sulfur By-product"

**M/s Reliance Industries Limited, Mumbai**

Tons of sulfur is produced annually at Reliance as a byproduct of refinery process. Our work is focused to develop specialty polymers using refinery sulfur as reactant to produce value added products. A number of sulfur based polymers synthesized and characterized having the three dimensional polymeric forms. Sulfur based polymers found application as concrete material to replace cement based concrete in civil engineering applications.



**M/s Reliance Industries Limited is the RUNNER-UP of National Awards 2014-15 under the Industry Category of "Innovation in Polymeric Material"**

**Shri Naman J. More**

**Dr. RadhashyamGiri**

**Central Institute of Plastics Engineering &Technology** (CIPET) is a premier National Institution devoted to Academic, Technology Support & Research (ATR) for the Plastics & allied industries in the India. Today CIPET operates on hub & spokes model with 23 locations spread across the length & breadth of the country, which includes 5 – High Learning Centres, 11-Other Learning Centres, 2 – R&D Wings, 4 – Specialized Centres, 2 – Vocational Training Centres. All the CIPET Centres have uniform infrastructural facilities in the areas of Design, CAD/CAM/CAE, Tooling, Plastics Processing, Testing & Quality Control to cater to the needs of plastics and allied industries in the country.

CIPET offers blend of various specialized Academic Programmes in the field of Plastics Engineering & Technology (Doctoral, Post Graduate, Undergraduate, Post Diploma or Diploma) in order to provide qualified human resources to plastics & allied industries. The Technology Support Service (TSS) to the industries and ingenious Research are the important product portfolios of CIPET.

**Shri Naman J. More** is a plastic Engineer Graduated from Gujarat Technological University passed out from CIPET Ahmedabad on 2014. Currently he is working in CIPET Murthal as an Assistant Technical officer. He got first prize in Technical poster presentation competition of "Tech Feast 2014" at Bhubneaswar. He got first rank in Project Fair of Gujarat Technological University 2014. He got Facilitated Shri Dewang Mehta Excellence Award for Communication Skills & English of Gujarat Technological University 2014.He always looking forward to Novel ideas & implementing views to innovative product.

**Dr. Radhashyam Giri ,** had completed his Master of Science (M.Sc) in Industrial Chemistry from Sambalpur University, Sambalpur. He received Master of Technology (M. Tech) degree in Plastics Engineering and Technology in 2007 from CIPET under Biju PAttanaik University of Technoloogy (BPUT) Rourkela. He received Doctor of Philosophy (Ph.D) from Rubber Technology Centre, Indian Institute of Technology, Kharagpur. He has seven international peer reviewed journal papers, one book chapter & 21 international oral conference papers on his credit. He is presently working as a Lecturer in CIPET Ahmedabad.

Central Institute of Plastics Engineering &Technology

## INNOVATION IN POLYMERIC MATERIAL

"Development of Thermoplastic Green Composites by the Utilization of Bagasse Waste from Sugar Industries"

**Central Institute of Plastics Engineering &Technology**

The objective is to develop green composites which will degrade in the Natural environmental conditions. Sugarcane Bagasse fibers will be utilized as filler in polypropylene thermoplastics with or without surface modification. These new environment friendly composites with comparable Mechanical & Biodegradable properties may likely to replace the non degradable plastic parts in major applications like Defense, Aerospace, Automobile, Electronics ,Electrical & Packaging application.

These natural fillers have several advantages such as their low cost, renewability &Biodegradability. This is a commercial importance from the environmental friendly materials which are natural to CO2emission & reduce the consumption of synthetic thermoplastic derived from petroleum sources.

In this Innovation sugarcane Baggase (SCB) waste as reinforcing filler in the thermoplastic polymer matrix , SCB reinforced polypropylene (PP) composite were prepared by the extrusion of PP resin with 10, 20 & 30 wt % of treated & untreated SCB filler in a co-rotating twin screw extruder. The extruded strands where cut into pellets & injection molded to make test specimen. The tests performed on the specimens to compare Mechanical properties (Tensile, Flexural, Impact, compression, Hardness),Thermal properties (HDT, DSC, TGA), MFI, scanning electron microscope (SEM), FTIR . Biodegradability in soil burial test performed to compare the weight of specimen before buried in the soil and after removed from soil.



**Central Institute of Plastics Engineering &Technology is the RUNNER-UP of National Awards 2014-15 under the Academics and R&D Institution Category of "Innovation in Polymeric Material"**

**Prof. Dr. Ajay Chandak**

**Prof. Dr. Ajay Chandak** has Ph.D. in solar energy and is M.Tech. from IIT Bombay, with 30 years of experience. Innovation and R&D are his traits and his passion for renewable energy initiated 36 patents, many of which are commercialized. He has worked as a 'Consultant' for United Nations and for Ministry of New and Renewable Energy. He is elected board of directors of 'International Solar Energy Society' and is also member of 12 professional bodies. He has published 50 research papers in journals and international and national conferences and also delivered more than 100 expert lectures, key note addresses etc. at international and national events. He is conferred with energy awards by Govt. of Maharashtra four times and also by 'Shirin Gadhia Sustainability Award 2011,'Engineering Achievement Award' by Institute of Engineers and national level best innovations awards in 2009 and 2011 for his solar cookers and biogas plants. He is a founder and chairperson of voluntary group PRINCE (Promoters, Researchers & Innovators in New & Clean Energy). He has been instrumental in developing many entrepreneurs in renewable energy sector by organizing 18 training workshops all over India. He is instrumental in motivating resources to install renewable energy projects in many social and charitable organisations in solar cooking, biogas plants, biomass gasification etc.

PRINCE
PROMOTERS, RESEARCHERS & INNOVATORS IN NEW & CLEAN ENERGY

**PRINCE, Suman Foundation**

## INNOVATION IN POLYMERIC PRODUCTS

"Prince Biogas Plant"

**Prof. Dr. Ajay Chandak**

Biogas is the most promising renewable technology in India that can provide clean cooking fuel and also combat climate change to large extent. Conventional biogas plant design using concrete domes or steel drums demand high skills, require more space, construction time in weeks and are expensive. Use of plastics for new design has solved problems of cost and corrosion. PRINCE floating drum prefabricated biogas plant has many features like centrally guided system, addition of weights to adjust delivery pressure of biogas, stackable components to reduce transportation cost, bendless inlet and outlet connections avoid choking, modular construction allows installation within two hours, provision of water jacket etc. The biogas plants work for feed material like cow dung as well as for food waste. These biogas plants can play a major role in management of food waste and cow dung, in urban as well as rural areas and can contribute a lot in ongoing 'Swatchh Bharat' abhiyan. Adoption of the biogas plants on large scale at rural level will provide clean smoke free cooking fuel and bring fuel security in the village. It will have positive contribution to health of rural women. Adoption of this innovation will reduce dependence on firewood and save trees, while it will also contribute greatly to combating climate change. Global warming potential of methane is 21 times more than CO2 and such biogas plants are the most promising alternatives to achieve emission reduction targets for country like India.



**Prof. Dr. Ajay Chandak is the RUNNER-UP of National Awards 2014-15 under the Individual Category of "Innovation in Polymeric Products"**

**Shri Rahul Pathak**
Managing Partner

**Shri Vikram Karunakaram**
Partner

**M/s. Uniqflux Membranes LLP,** a start up company established in 2010 is the first company in India to produce indigenous TFC RO membranes, Hollow Fibre, Micro Fibre & Ultra Filtration Membranes under the licence from CSIR-CSMCRI, Gujarat. Uniqflux Membranes LLP has set up fully Indigenous Membranes manufacturing facility in Pune & is capable of producing Membranes for various applications.

**Shri Rahul Pathak** and **Shri Vikram Karunakaram** have been pioneers in taking the technology to commercial scale with Business projections of 200Cr. in the next 5 Yrs. Uniqflux Membranes LLP, pune has been awarded by Hari Malini Innovation Award by MCCIA, Leadership Excellence Award 2014 and BOI India SME 100 Award.

**M/s Uniqflux Membranes LLP, Pune**

## INNOVATION IN POLYMERIC PRODUCTS

"TFC Reverse Osmosis Membrane"

**M/s Uniqflux Membranes LLP, Pune**

Water is one of the most important resources for human existence, whether it be for human consumption, agriculture and industry. Ensuring access to safe drinking water is emerging as one of the important challenges of the present century because of steady decrease in the available water resources, industrialization, urbanization, etc. Water in several pockets of the country contains high salinity, and/or harmful contaminants. Desalination of brackish and sea water and water refinement are the major requirements for solving this challenge.

Membrane separation processes such as reverse osmosis (RO), Nano Filtration (NF) and Ultra Filtration (UF) have emerged as an effective solution to produce safe drinking water. CSMCRI has pioneered the membrane research and development in the country for desalination of brackish and sea water,and for water refinement i.e. removal of harmful contaminants like pathogens, hardness, arsenic, fluoride, etc., present in water.



**M/s Uniqflux Membranes LLP is the WINNER of National Awards 2014-15 under the Industry Category of "Innovation in Polymeric Products"**

**Shri Nediyara Bhaskaran**

**CARRIS PIPES & TUBES (P) Ltd** was formed by a group of technocrats in 1996.In a short span it has climbed up the ladder to be the largest producer of water storage tanks in South India and the second largest in the national level. Made by Bi-axial Rotomoulding technology, Injection moulding and guaranteed by stringent quality standards, Aquatech is the brand name & its products conform to global standards of quality, safety and durability. The products range includes water tank ,septic tank, biogas plant, flush tank, cold box, Automotive, seat cover and other Custom mould products on customer specifications. Our first manufacturing unit is located at Perumbavoor, Ernakulam district, KERALA with an installed capacity to produce four lakh litres per day. Shortly Aquatech spread its wings to the states of TAMILNADU, KARNATAKA, GOA and Andhra Pradesh.In 2002 the unit was granted ISI Certificate by the Bureau of INDIAN Standards. Within this period the group excelled in expertise to manufacture highly technical products like logistic drop box used by **DEFENCE** Services, motor car bumpers, Diesel tanks for motor vehicles and generators, Detergent Reservoirs for some cleaning equipments exported to foreign countries etc .,to name a few.

In the year 2004 the company opened its third manufacturing unit in pedauttapaali, ganavaram, Vijayawada, Andhra Pradesh for better coverage of AP and ORISSA.In the same year the units were awarded **ISO certification** for the management system followed.In the year 2009 the company became approved vendors for Ordnance Factory, TRICHY directly run by the **Ministry of Defence.**

In the year 2012 company was awarded the certificate of membership by T**HE SOCIETY OF ASIAN ROMOULDERS** as star member. In the same year company was awarded the license to use the know-how for the manufacturing of "NIIST ANAEROBIC DIGESTER CUM HOUSEHOLD BIOGAS PLANT" developed by NATIONAL INSTITUTE FOR INTERDISCIPLINARY SCIENCE & TECHNOLOGY (NIIST) of COUNCIL OF SCIENCE AND INDUSTRIAL RESEARCH (CSIR). The group holds valid NSIC registration and **NSIC-CRISIL 'SE 1A'** performance and credit rating which indicate Highest Performance Capability and High Financial Strength.

N**.BHASKARAN - Managing Director: - Shri.Nediyara Bhaskaran** aged 71 years is the son of Shri. N Narayanan. He is a graduate in electrical engineering from the College of Engineering, Trivandrum, started his first PVC unit in the year of 1974 with name and style "Nediyara Chemicals". This was one of the pioneer PVC pipe manufacturing units in Kerala. In the year 1981 he started his second unit namely Nediyara Plastics for the manufacture of PVC pipes. Latter, he set up an injection-moulding unit namely Deepa Plastics and Polymers at Parapukara in Trichur District for the manufacture of sanitary moulded articles like toilet seat covers and cisterns. This happens to be the first injection-moulding unit in south India in this line of activity. In 1987 he along with his brother Mr.N.Suresh and Mr.T.P.Saji commenced a unit for the manufacture of PVC pipes under the banner Chloroplast. He was also instrumental in setting up the industrial units of Lyka Olefins and Lyka Aesthetics (P) Ltd (manufacturers of multicolour printed food containers) and Nediyara Extrusions (P) Ltd (manufacturers of PVC pipes).

AQUA EXTRA TOUGH TECH

**M/s Carris Pipes & Tubes Pvt Ltd,**
**Perumbavoor, Cochin – Kerala**

## INNOVATION IN POLYMERIC PRODUCTS

"Aquatech Biogas Plant"

**M/s Carris Pipes & Tubes Pvt. Ltd., Perumbavoor**

**Complete treatment system for household biodegradable wastes- cooked and uncooked food materials**

To overcome the energy crisis, alternate energy sources are the only remedy. The newly developed biogas plant is a complete treatment system for the biodegradable household wastes including cooked and uncooked food materials. it stabilizes waste as compost manure and generates methane rich biogas from wastes at the source of generation.

a) This invention effects safe disposal of household biodegradable wastes, utilization of waste biodegradables, conversion of wastes materials to stable compost, utilization of inert lignocellulosic wastes for steady release of nutrients, increased retention of moisture in soil, crop plants, and application of the material to provide better aeration and preventing compaction of soil which facilitates improved agriculture. b) This invention avoids use of extra water for anaerobic digestion as required in the routinely used domestic biogas plants worldwide. c) This invention equips nutrients recovery and their utilization at the source of wastes generation free of costs. d) This invention also enables easy handling, transportation and direct use of stabilized compost conveniently. e) This invention also facilitates conversion of stored carbon in the organic materials to generate methane and its collection and direct use for fuel purposes at the source, which avoids storage/ transportation costs or emission hazard. f) This invention leads to decentralized processing of biodegradable wastes that can avoid difficulty in collection, multilevel segregation, emission hazards in transportation and handling areas, and reduces public burdens on centralized treatments.

1) The present anaerobic digester is compact (1/3rd smaller in size compared to the existing commercial models and therefore cost savings on materials and requires less footprint), 2) free of pollution and 3) mosquito breeding from discharges (complete solution to waste management), 4) biogas contains higher (more than 75% methane) and less carbon dioxide (less than 25%) that results in higher fuel efficiency, 5) less volume discharge around 1 kg (easy to store for specific compost applications) compared to more than 10 litres of the commercial models. 6) In addition to the above the present digester could decompose all biodegradable wastes unlike in the existing household biogas plants.

Shri J. Ramaswamy Setty

Shri G.M. Kamalakannan

Shri G.N. Dayananda

**National Aerospace Laboratories (NAL),** a constituent of Council of Scientific and Industrial Research (CSIR), is India's only pre-eminent high technology oriented civil R&D institution in aeronautics and allied disciplines. Its contributions over last five decades have enabled it to create a niche in advanced aerospace research and technology developments.

**Shri J. Ramaswamy setty** is a Principal Scientist and coordinator for Marketing and Development of Indigenous Autoclaves at the Centre for Societal Missions and Special Technologies, **CSIR- National Aerospace Laboratories (NAL), Bengaluru.** He has obtained Masters Degree in Machine Design from Indian Institute of Technology, Madras. He has over two decades of experience in Design and Development of Special purpose equipments including autoclaves. He has designed largest autoclave in the country with several innovative features and developed indigenous capability in manufacturing of large autoclaves.He has successfully executed the Revamping and Re-installation of the Reaves curing chamber and Baron autoclave for the VSSC, Thiruvananthapuram. He has designed and fabricated an cost-effective 8-axis X-ray manipulator. He was instrumental in forging the Public Private Partnership (PPP) with M/s. Unique Chemoplant Equipments, Mumbai for Marketing and Manufacturing of Aerospace grade autoclaves to process Polymeric composites. He is also working in the area of 3-D composites.His team has won the BIREN ROY TRUST AWARD for the year 2009 in recognition of his contributions in the field of design, development, maintenance, operation, training, manufacturing and allied areas of aviation and space.

**Shri G.M.Kamalakannan** is Principal Scientist and Deputy Head of the Centre for Societal Missions and Special Technologies **(CSMST), CSIR-NAL,** Bengaluru. He obtained his Masters degree in Applied Electronics Engg. from the Visvesvaraya Technological University, Karnataka. He has over two decades of R&D experience in the design and development of Electronic systems, Application software and products for aerospace composites processing. His research interests also include morphing Micro Air Vehicles and smart actuators. He has played an important role in developing the indigenous Aerospace grade autoclave technology, which is successfully commercialized through a PPP (Public Private Partnership) arrangement. He has designed, developed and commissioned the **Control and Instrumentation (C&I) and software systems** for number of autoclaves both within and outside NAL including the largest one in the country.

Other products designed and developed by him include the indigenous **Cure controller, Multi-zone hot bonder, Multi-axes X-ray system manipulator** (C&I) and **Automated Resin Infusion System** for composites manufacturing etc., which are used in IAF, R&D Engineers, HAL and NAL.

He is a recipient of CSIR-NAL – Technology shield (2010), Dr.Biren Roy Trust award (2010) and ISAMPE award (2007).

**Dr. G.N.DAYANANDA** is Chief Scientist and the Head of the Centre for Societal Missions and Special Technologies, National Aerospace Laboratories (NAL), Bengaluru. He obtained both his Bachelor's in Mechanical Engineering (in 1984) and Masters in Machine Design (in 1987) from University College of Engineering, Bangalore. He was awarded the prestigious Doctor of Science degree by Mangalore University for his work on smart materials in 2010. He won the VASVIK award for the year 2011 in recognition of his contributions to the indigenization of autoclave process equipment used in manufacturing aerospace composite structural components for the major aircraft programs.

**CSIR-National Aerospace Laboratories, Bangalore**

## INNOVATION OF POLYMER PROCESSING MACHINERY & EQUIPMENTS

"Design and Development of Indigenous State-of-the-Art Aerospace Grade Autoclave (Polymer Processing Equipment) for Manufacturing Advanced Composites"

**Shri J. Ramaswamy Setty, Shri G.M. Kamalakannan & Shri G.N. Dayananda**

Autoclave processing of polymer composite based aircraft structural components for airframes is referred to as the gold standard in the aerospace industry. Investments in autoclaves are considered to be strategically important.

The significance of the activities at the centre is evident from the impact on aerospace, societal and educational sectors in the country ( particularly in the field of advanced composite processing using autoclaves ) and the niche space garnered in the area of polymer composite air borne and ground based radomes.

The **Significance of the Innovation** relates to successful realization of a large indigenous state-of-the-art autoclave as well as a high temperature and high pressure autoclave for aerospace applications.

Autoclaves are key equipment for processing advanced composites structures for aerospace applications. Composites structures for nationally important aircraft programs, such as LCA (Light Combat Aircraft) and SARAS (Light Transport Aircraft) were processed successfully in the autoclaves.

In order to **test market** the technology first within the country before embarking on global outreach, CSIR-NAL, has formed a PPP (Public Private Partnership arrangement) with M/s. UCE, Mumbai, and Ms/. Datasol, Bengaluru.

Lab scale autoclaves for the prestigious educational institutions in the country viz; IIT, Kanpur and MIT, Manipal have been successfully commissioned. VSSC, Trivandrum and ASL, DRDO, Hyderabad will be getting autoclaves soon from the NAL led consortium.



**Team – Shri J. Ramaswamy Setty, Shri G.M. Kamalakannan & Shri G.N. Dayananda is the WINNER of National Awards 2014-15 under the Team Category of "Innovation of Polymer Processing Machinery & Equipments"**

**Shri Kaushik Bhuva**

**Ferromatik Milacron India** is part of Milacron LLC, USA, a Global Leader in business areas of Plastics Processing Technologies, Metal Working Fluids and Precision Machining with group revenue in excess of US$ 1.2Billion supported by manufacturing credentials accrued over 130 years.

Ferromatik Milacron India is the leading manufacturer of Plastics Injection Moulding Machines & Blow Moulding Machines in India, serving the entire gamut of Plastic Applications in 40 countries across the world in SAARC, Middle East & Africa including USA. Established in 1995, it offers today the Full Range of Injection Moulding Machines from 50 Ton to 3200 Ton with capacity to manufacture 1500 machines per annum and a PAN India Sales & Service Offices in major cities and industrial towns of the country. It is accredited to the Export House Status and is an ISO 9001:2008 and ISO 14001:2004 certified company adhering to World Class Quality Standards.

**Shri Kaushik Bhuva** graduated as a Mechanical Engineer from L.D. College of Engineering, Ahmedabad in the year 1999. He has 15 years of experience in Machine Design. He joined Ferromatik Milacron India in 2003 and currently holds position as Senior Manager- Design & Development. He is mainly responsible for the development of Toggle Plastic Injection moulding machines and product enhancements.

FERROMATIK MILACRON

**M/s Ferromatik Milacron India Pvt. Ltd., Ahmedabad**

## INNOVATION OF POLYMER PROCESSING MACHINERY & EQUIPMENTS

"Elektron 450 - All Electric Plastic Injection Molding Machine"

**M/s Ferromatik Milacron India Pvt. Ltd., Ahmedabad**

Energy cost is a concern in every segment and in every corner of the world. Energy and raw material consumption have highest cost impact in the processing of plastics. Along with this, environment friendly manufacturing with minimal maintenance and clean operation are today's requirement in the Plastic Injection Molding. It is necessary to have the technology providing solution in all these areas. Fully Electric machines ELEKTRON 50T to 650T are meeting this entire requirement.

ELEKTRON 450 is a "Green" machine best suitable for Automotive, Packaging and clean room application. Removing the hydraulic system from this machine is one of the major effects with this product and this removes a significant variable from the injection moulding process. This gives excellent Accuracy, Repeatability and Consistency resulting Higher Part Quality. Energy consumption in this machine is 30~50% lower compare to hydraulic machine. Every function has its own Servo motor and drive, hence parallel operation is possible resulting in reduced cycle time up to 20% depending on articles to be produced. As there is no hydraulic system present, there is no requirement for hydraulic oil to be stocked, filtered, changed or disposed off – all operations that take time, cost money and use energy. No oil so no requirement of oil filters and disposal of used filters to the environment.

***All Electric Plastic Injection Molding machines are "Future necessity of all plastic processor"***

**Shri P. M. Jariwala**

**Kabra Extrusiontechnik Ltd. (KET)** is a part of renowned Kolsite Group. It began its operations in 1962. With over 5 decades of experience in extrusion technology, KET continues to be a leader in manufacturing & export of plastic extrusion machinery. KET offers a wide spectrum of modern extrusion machinery with customizable solutions to its esteemed customers.

A large number of extrusion plants, equipments manufactured at KET are efficiently working in India & more than 72 countries including Europe, US, Gulf, and, Africa region. KET is a ISO 9001 : 2000 company with a Two Star Export House & Five Time Winner of the coveted " Excellence in Export " award.

Since last five decades, Kabra ExtrusionTechnik has always explored latest options for its valued customers with its in-house R&D and advanced technical processes for plastic extrusion. To serve customers better, Kabra has two state-of-the-art manufacturing facilities spread over a combined area of 83820 m2 at Daman, India. The JV with world leaders – such as battenfeld cincinnati (Germany, Austria, USA) and Gloucester Engineering (USA), being an added advantage. Kabra has been benchmarking in plastics extrusion industry by sophisticated R & D techniques and various processes to cater to the market requirements for low power consumption, high output, maintenance free and user friendly Plastics Extrusion plants and machineries.

**KET offers following major product lines viz.**

- Extrusion lines for PVC, CPVC, PVC Foam Core, Polyolefins, and, PP-R pipes
- Twin screw lines for extrusion of RPVC/ cPVC pipes, PVC profiles & pellets
- Single screw extrusion lines for PO pipes
- High Speed Flat/Round Drip Tube lines
- Mono, Multi Layer Blown Film Lines
- High Capacity Mixer-coolers
- Downstream and auxiliary equipments for pipe & film plants.

KABRA ExtrusionTechnik

**M/s Kabra Extrusiontechnik Ltd., Mumbai**

## INNOVATION OF POLYMER PROCESSING MACHINERY & EQUIPMENTS

"High Speed Inline Flat Drip Tube Extrusion line"

**M/s Kabra Extrusiontechnik Ltd., Mumbai**

**High Speed Inline Flat Drip Tube Extrusion Line is designed and manufactured to deliver :**

- High line speed upto 250mtrs./min. against available machine from 20-80mtrs./min.
- Linear specific output due to spiral groove feed Barrel against non linear specific out with straight groove feed Barrel.
- Surge free melt flow which is very essential for the production of thin tube at high line speed.
- 4-Component Gravimetric dosing & mixing system for very accurate blending & homogeneous mixing. The system is with line control for quick startup and controlled weight / meter and uninterrupted production.
- Machine configured for wide range of tube thicknesses from 0.15mm to 1.2mm. This enables to produce ISI grade as well as commercial grade product.
- Partially import substitute.
- Low energy consumption upto 0.26 unit/kg. This is equivalent to 5 paisa/meter for 16mm x 0.8mm tube.
- High production rate of thin wall tube of 0.15mm, 0.2mm and 0.25mm enables to reduce end product cost.

Prof. P.A.Parikh

Dr. Yogesh C. Rotliwala

Shri Dharmendra B. Parekh

**Prof. Parimal A Parikh** is with Chemical Engineering Department, S.V National Institute of Technology, Surat. He is DAAD Fellowship holder. He remained Dean (Research & Consultancy) at his Institute. He has so far guided 8 Ph.D. and about 25 M.Tech. thesis. He has authored more than 80 research papers. He has been awarded with various research grants. His research interests include catalysis of petroleum refining, petrochemicals and biomass conversion processes.

**Dr. Yogesh C. Rotliwala** is a Professor & Head of Chemical Engineering, S. N. Patel Institute of Technology & Research Centre, since 2009. He has received his Ph.D. from V.N. South Gujarat University, Gujarat, in the field of resource recovery from waste plastics and biomass. His current research interests include renewable energy driven technologies such as bio-gas and bio-diesel from various feed stocks, biomass-waste plastics and municipal solid waste pyrolysis, waste separation technology and waste water treatment. He has published more than 25 research papers in reputed international journals, conferences and completed several Government sponsored R & D projects. Beyond his extensive research success, he has been fortunate to obtain a wide range of teaching experiences, included teaching assistant, instructor, and mentor.

Under his supervision, more than 400 environmental audits have been carried out for the various industries of the Gujarat state. He holds the “Noel Deerr Gold Medal 2010” sponsored by Sugar Technologists Association of India and “ISTE National Award 2014” for outstanding research in the field of renewable energy.

**Shri Dharmendra B Parekh** Master of Environmental Science and pursuing his doctoral in renewable energy. Mr. Parekh is a scientist at, Centre for Environmental Research, S.N.Patel Institute of Technology and Research Centre, since 2010. He possess expertise in the field of bio fuels. He is also one of those first time entrepreneurs who saw potential in an inchoate idea, ventured into it, and established it workability. MCX, India and many others awarded him for his remarkable contribution in framework for Biofuel Industries. Recently, he is engaged with his team to develop indigenous technology for separation of MSW and co-pyrolysis of non-biodegradable waste material. His de-centralized waste management concept is examined by several local bodies and recently they implement in practice. He has successfully completed several Government sponsored R&D projects. Many young entrepreneurs are inspired by him to invest in the field of renewable energy on his theme of “ZERO LANDFILL- NO DISCHARGE is remarkable.

S.N.Patel Institute of Technology & Research Centre, Surat

S.V.National Institute of Technology, Surat - 395007

# INNOVATION IN POLYMER WASTE MANAGEMENT & RECYCLING TECHNOLOGY AND GREEN POLYMERIC MATERIALS & PRODUCTS

"Resource Recovery from Waste Plastics for the Up-Gradation of Biomass Derived Bio-oil"

**Prof. Parimal A.Parikh, Dr.Yogesh C. Rotliwala & Shri Dharmendra B. Parekh**

Thermo-chemical conversion of Biomass has been widely studied in recent years. However, bio-oil obtained from biomass is reported to be highly oxygenated, complex and chemically unstable. Due to the high proportion (35-50%wt.) of oxygen-containing compounds (e.g. aldehydes, ketones, hydroxyl acetaldehydes, organic acids, levoglucosan, furan derivatives and phenolic compounds) in biomass, they cause high water formation (25 % wt.), lower heating values (40–50% of diesel), high viscosity, immiscibility with conventional fuels, corrosive, oligomerization and phase separation. This limits its application as fuel oil. Thus, bio-oil needs to be upgraded by lowering the oxygen content. Various researchers have investigated different up-gradation techniques, e.g., hydro-deoxygenation, catalytic cracking, emulsification, steam reforming, esterification and reactive rectification. Nevertheless, these are so complicated techniques due to certain reasons. Recent literature shows remarkable advancement in the field of thermal co-processing of waste mixtures referred to as "co-pyrolysis". Due to high hydrogen content in plastics (HDPE and PP contain 14 wt.% of hydrogen, PS contains 8 wt.% of hydrogen), the effect of plastics as a hydrogen source in thermal co-processing known as in-situ hydrogenation, resulting in the improvement of yield and quality of obtained bio-oil from biomass.

The current innovation addresses the application of high hydrogen content of waste plastics for the production of upgraded bio-oil in an auger pyrolyser/ batch pyrolyser. It also addresses the development of mobile pyrolyser, which can operate on-farm and local Nagarpalika for the production of bio-oil and electricity from various waste plastics and waste biomass.

Dr D. Ratna

Shri R. Baloji Naik

**Dr. Debdatta Ratna** did his M.Sc (Chem), M. Tech in Materials Science & Engineering and Doctorate in Polymer Science from Indian Institute of Technology, Kharagpur. He was a visiting scientist to Monash University, Australia on BOYSCAST Fellowship in 2000, sponsored by DST, India. He was also a visiting scientist to Technical University, Kaiserslautern, Germany on a prestigious Alexander von Humboldt Fellowship from 2006 to 2008. Dr. Ratna has been working as a scientist in Naval Materials Research Laboratory (Defence research and development organization-DRDO), Ambernath, Maharastra for the last 21 years and developed several products for Indian Navy. He has published more than 80 papers in reputed international journals and a Rapra Review Report (UK). He is also the author of HANDBOOK OF THERMOSET RESINS published by Smithers Rapra Technology, United Kingdom. He is a referee for several international journals. He is the recipient of Institute silver Medal (IIT Kharagpur), Indian Paint association award, Technology day Medal (DRDO), Technology group award, Thermal analysis award (TA Instrument, UK). R. Baloji Naik did his M. Sc (Organic Chemistry) from Osmania University, Hyderabad and recently submitted (November 2015) thesis to University of Mumbai for award of Doctorate in Chemistry. R. Baloji Naik has been working as a scientist in Naval Materials Research Laboratory (Defence research and development organization-DRDO), Ambernath, Maharastra for the last 07 years and involved in the development of various organic coatings for Indian Navy. He has two Indian patents two his credit. He published and presented more than 15 papers in reputed international journals and national and international conferences. He is a SSPC Level-2 qualified person in the field of Paint Coating Inspection & Quality Control.

**Shri R. Baloji Naik** did his M. Sc (Organic Chemistry) from Osmania University, Hyderabad and recently submitted (November 2015) thesis to University of Mumbai for award of Doctorate in Chemistry. R. Baloji Naik has been working as a scientist in Naval Materials Research Laboratory (Defence research and development organization-DRDO), Ambernath, Maharastra for the last 07 years and involved in the development of various organic coatings for Indian Navy. He has two Indian patents two his credit. He published and presented more than 15 papers in reputed international journals and national and international conferences. He is a SSPC Level-2 qualified person in the field of Paint Coating Inspection & Quality Control.

**M/s Naval Materials Research Laboratory (NMRL), Ambarnath**

## INNOVATION IN POLYMER WASTE MANAGEMENT & RECYCLING TECHNOLOGY AND GREEN POLYMERIC MATERIALS & PRODUCTS

"Development of Green Antimicrobial Coating based on Silver Nanoparticle Embedded Hyper branched urethane Alkyd Resin"

**Dr. D. Ratna & Shri R. Baloji Naik**

Protecting the environment without compromising development is the need of the day. This can be done by making the materials and process technology greener and greener. We have developed a new class of hyperbranched urethane alkyd-silver nano composite based antimicrobial coating, which is useful as binder for protecting wide variety of substrates against bacterial growth. The hyperbranched urethane alkyd resin used in this work offers advantages of both urethane and alkyd resins. The idea behind using hyperbranched polymer is that they can be processed with much lower amounts of solvent (volatile organic compounds) because of their inherent lower viscosity compared to the linear analogue. We have used silver nanoparticle (SNPs) as antimicrobial agent in place of toxic biocides because of their less toxicity to human and high toxicity to bacteria. SNPs were generated in-situ without using any external reducing agent. The naturally occurring oxidative drying of hyperbranched alkyd-urethane resin reduces the silver benzoate leading to the in-situ formation of SNPs. Note that the reducing agents generally used for in-situ generation of metal nanoparticles are toxic to human beings. In addition to two-pack coating system, we have also developed a moisture curable coating system which will be useful in high humid area for example marine application. Thus, the process is new and comparatively greener as it involves minimum use of solvent and it does not use any toxic reducing agents for the synthesis of SNP-based nanocomposites. Therefore, the developed coating will get broad application in both civil and defence applications.

**Shri A.S. Vishnoi**

**Maharani Innovative Paints Pvt. Ltd.,** a wholly owned subsidiary of Maharani Paints Pvt. Ltd., is a Private Limited company manufacturing Industrial Paints and allied Products for OEM Users in the Automobile Industry.

It has strong R&D Department with state of art equipment. We have indigenously developed HR Paints, and also Eco-Friendly Clean Technology for Recycling of Industrial Paint Sludge into Industrial Useable Coating Material which has been patented.

The company's desire to contribute to save environment, to counteract the depletion of the natural resources, environmental impact of the waste on the flora fauna and the soil; with the specific concern to the Hazardous Waste generated by the Industrial Paint users; led us to do research and arrive at this Clean Innovative Technology. This technology is constantly being developed for multifunctional utilities.

Before the development of our Eco-Friendly Clean Technology the Industrial Paint Sludge was either being Incinerated or it was being disposed off at TSDF Sites after due stabilization. Both these processes were not Eco-Friendly, as incineration causes emission of gases, contributing to global warming and leaving residual ash, which has to be disposed off, at a secured Hazardous Waste Disposal Site (Landfill), after due treatment.

MPPL

## INNOVATION IN POLYMER WASTE MANAGEMENT & RECYCLING TECHNOLOGY AND GREEN POLYMERIC MATERIALS & PRODUCTS

"Recycling of Industrial paint Sludge to Industrially useable Coating Materials"

**M/s Maharani Innovative Paints Pvt. Ltd., Faridabad**

The **Clean Innovative Technology of Converting Paint Sludge** has been successfully implemented commercially for more than last 8 years in big International Companies and is being adopted by many World renowned Automobile Companies.

A applied for patents in different countries like Japan, Europe, USA, Indonesia, Canada, and Korea. Canadian and Korean Patents have already been granted to us and the others are in process.

The Clean Innovative Technology contributes towards the major issue of minimizing the Hazardous Waste; it counteracts the depletion of scarce Natural Resources and Raw Materials. It protects the atmosphere from the gaseous pollution, thus contribute to the reduction of global warming. It protects the flora & fauna of the area, along with prevention of deterioration of the soil fertility. Thus it is totally an eco-friendly concept for Recycling of Hazardous Waste to useful material, which is the need of the Hour!!



M/s Maharani Innovative Paints Pvt. Limited is the WINNER of National Awards 2014-15 under the Industry Category of "Innovation in Polymer Waste Management & Recycling Technology and Green Polymeric Materials & Products"

**Shri Sunder Balakrishnan**

**Natur-Tec® India Pvt. Ltd** (www.naturtec.in), a subsidiary of Northern Technologies Corporation (www.ntic.com), U.S.A., engineers and manufactures bio-based and compostable plastics intended to replace conventional, petroleum-based plastics. Natur-Tec® has a broad bio-plastics portfolio which spans flexible film, rigid injection molded materials, and engineered plastics. These applications allow for the production of 100% certified biodegradable and compostable finished products, such as bags, foodservice products, and product packaging.

Natur-Tec® products are renewable resource-based and do not contain conventional plastic materials. Natur-Tec® products provide sustainable alternatives to conventional plastics and enable industry and consumers to move closer to a carbon neutral footprint.

Northern Technologies International Corporation ("NTIC") U.S.A. focuses on developing, marketing and selling proprietary environmentally beneficial material science-based product and technical services via a network of independent distributors, manufacturers' representatives and joint ventures in over 50 countries.

Natur-Tec®
Sustainable Biobased Materials

**M/s NATUR TEC INDIA PVT. LTD**

## INNOVATION IN POLYMER WASTE MANAGEMENT & RECYCLING TECHNOLOGY AND GREEN POLYMERIC MATERIALS & PRODUCTS

"Bio-based and Biodegradable Packaging for Apparels"

**M/s Natur-Tec India Pvt. Ltd.**

There are growing concerns worldwide relating to a product's sustainability, carbon footprint and environmentally responsible end-of-life. Natur-Tec®'s bio-based and biodegradable-compostable hybrid materials are based on Poly (lactide) (PLA) resins derived from plant-biomass feedstock like corn, and sugarcane instead of fossil/petroleum. Using innovative chemistry and process engineering, the commercial PLA resin was chemically modified and physically blended with fillers, modifiers, and additives to meet cost-performance requirements of target applications.

**Natur-Tec®** has successfully introduced the new bio-based and biodegradable-composting plastic bags to International brand garment manufacturers as an environmentally responsible end-of-life option with a reduced carbon footprint. This is consistent with major garment brand owner's sustainable, environmentally responsible product strategy. They used petro-fossil based non-biodegradable polyethylene plastics to package and transport the garment to their Distribution Centers in the U.S. and Europe. The biodegradable-compostable plastic garment bags provides an environmentally responsible end-of-life packaging solution wherein the packaging would be completely removed from the environment via microbial metabolism in composting disposal systems. This packaging innovation is in line with the packaging waste directives in the E.U. Natur-Tec® worked closely with the brand owner to design and engineer a biobased and biodegradable-compostable plastic garment bag that met all the performance requirements set by the company for the garment bag while providing additional environmental value attribute of biodegradability-compostability and reduced carbon footprint. Further, the product meets RSL requirements and is certified Biodegradable & Compostable as per International Standards such as ASTM D6400, EN 13432 and ISO 17088.



M/s Natur Tec India Pvt. Limited is the RUNNER-UP of National Awards 2014-15 under the Industry Category of "Innovation in Polymer Waste Management & Recycling Technology and Green Polymeric Materials & Products"

Prof. Arup Mukherjee

Shri Farrooque

Shri Rajesh Saw

The University of Calcutta was founded on January 24th 1857 by the incorporation of an act of the legislative council at that time. The university is one of the oldest in the country and carries many laurels and many first. The University science college was established in 1924 and was also the first in India. This University but relentlessly caters to the intellectual and scientific needs for the common and youthful India. One of the newest in that effort is a Center for Research in Nanoscience and Nanotechnology established through a benevolent grant from the Govt of India. This was a great support intended for a vertical and horizontal integration on multidisciplinary research among different departments in the University. Today, 63 faculty members, many students and researchers from 22 departments collaborate through that center and contribute significantly in knowledge development and dissipation.

**Professor Arup Mukherjee** Ph.D., FRSC, is a Professor of Chemical Technology and the coordinator for the Center for Research in Nanoscience and Nanotechnology, University of Calcutta. Professor Mukherjee is a Ph.D. from Jadavpur University, India and a post doctoral fellow from MIT, USA. Research interests of his group include Biopolymer nanotechnology, Drug delivery and Biopolymer modifications for environmental applications. Professor Mukherjee is widely travelled in India and abroad. He has produced 17 Ph.D. scholars so far and all are very successful globally in science & technology areas.

**Department of Chemical Technology and the Center for Research in Nanoscience and Nanotechnology, University of Calcutta**

## INNOVATION IN POLYMER WASTE MANAGEMENT & RECYCLING TECHNOLOGY AND GREEN POLYMERIC MATERIALS & PRODUCTS

"Magnetically Guided water Submerged Biopolymer Films for Synchronous Decontamination of Pollutants and Bacteria"

**M/s Department of Chemical Technology and the Centre for Research in Nanoscience and Nanotechnology, University of Calcutta**

This Innovation refers to submergible robotic biopolymer films for at site water cleaning applications. Guar gum is hydrophobic modified at the surface with benzoyl groups for enhanced sorption of organic pollutants from water environment. Further, super-paramagnetic iron oxide nanoparticles were synthesized and core-shell coated in a catechol mussel adhesive reaction. Magnetic iron oxide nanoparticles were uniformly dispersed in the benzoylated guar gum cast films and were applied as multifunctional water cleaners. The magnetic biopolymer films can remain submerged for a long time in polluted water and water-muds for an effective sorption of reservoir ions and pollutants like plastics decomposition products and endocrine disrupting agents. The films additionally exert bacterial contact killing due to iron oxides and biopolymer surface phenyl groups. Furthermore, the magnetic biopolymer films can be fished out at will, reused after desorption or be driven around in water environment without physical contact but using only a remotely held low intensity bar magnet.



Department of Chemical Technology and the Centre for Research in Nanoscience and Nanotechnology, University of Calcutta is the RUNNER-UP of National Awards 2014-15 under the Academics and R & D Institution Category of "Innovation in Polymer Waste Management & Recycling Technology and Green Polymeric Materials & Products"

Dr. Anupama Singh

Dr. Balraj S. Parmar

Dr. Dhruba Jyoti Sarkar

**Dr. Anupama Singh** Principal Scientist at Indian Agricultural Research Institute (ICAR-IARI), New Delhi, has research experience of 17 years on development and formulation aspects of hydrogels. A recipient of prestigious awards such as ICAR and National Academy of Agricultural Sciences Young Scientist Recognition Awards, she has eight licensings of her work on hydrogel and has over 70 publications including patents and research papers, among others. Along with Dr. BS Parmar, she has developed 'Pusa Hydrogel', a water conserving indigenous technology and a success story of IARI.

**Dr. Balraj S. Parmar** Former Joint Director (Research), Emeritus Scientist, ICAR-IARI and Former Head, Division of Agricultural Chemicals, ICAR-IARI is a Fellow of National Academy of Agricultural Sciences, India, and Society of Pesticide Science India, and is recipient of several prestigious national awards and other national and international recognitions for his contributions in the field of agrochemicals. He has 25 licensings of his scientific works to industry and over 470 scientific contributions including patents, books, research papers and others.

**Dr. Dhruba Jyoti Sarkar** Scientist at ICAR-IARI is recipient of ICAR's Jawaharlal Nehru Award for Outstanding Doctoral Thesis Research. He has been involved in research on agrochemical formulations such as hydrogel and composite chemistry, amphiphillic polymers and nano-formulations. He has around 20 publications including patents and research papers among others. He has been associated in the development of next generation hydrogels and hydrogel based formulations

The team's effort in developing integrated agro-input management approaches has generated enormous interest among stakeholders at national and international levels.

ICAR – IARI, Pusa, New Delhi

## POLYMERS IN AGRICULTURE AND WATER CONSERVATION

"Indigenous Bio Polymeric Superabsorbent Hydro gel Technology for Enhancement of water and Nutrient productivity and Novel process of preparation"

**Dr. Anupama Singh, Dr. Balraj S. Parmar & Dr. Dhruba Jyoti Sarkar**

Growing water scarcity is forcing the planners and researchers to search for water saving technologies and products for use in future. Along with low water productivity, low nutrient use efficiency is another major bottleneck in realizing sustainable agricultural productivity and food security for our posterity.The innovation selected for the award reports hydrogels and their value added derivatives, particularly the nutrient enriched products for enhancing the water and nutrient productivity in resource stressed Indian agriculture. The base product, 'Pusa Hydrogel', a novel indigenously developed cellulosic polyacrylate superabsorbent polymer is a declared success story of IARI. Its effect in enhancing water use efficiency of crops in areas with limited water availability is well established all across India.The technology has been licensed to eight companies and has been adopted extensively by the end users. The technology has also caught the attention of international community who is seeking rights for its commercialization abroad. The inventors have successfully further improved the economics of making these products to ensure their large scale production, and adoption by the farming community. The superabsorbent materials and their value added derivatives can now be prepared in a simple single step process with considerable reduction in the ratios of some of the costly reactants and reaction auxiliaries. This effort is expected to go a long way in increasing buyer affordability, benefit cost ratio and the ultimate adoption by masses.



**Team - Dr. Anupama Singh, Dr. Balraj S. Parmar & Dr. Dhruba Jyoti Sarkar is the WINNER of National Awards 2014-15 under the Category of "Polymers in Agriculture and Water Conservation"**

Dr. Nirmal Chandra

Dr. A. K. Srivastva

Dr. S. C. Pandey

**ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora** is a multi-crop research institute under the ICAR. The institute is dedicated to fulfill the research needs of North-Western Himalayan states viz., Uttarakhand, Himachal Pradesh and Jammu-Kashmir. Institute was initially named as Vivekananda Laboratory and was established in Kolkata on 4th July, 1924 by Padmabhushan Late Professor Boshi Sen. Later in 1936 this laboratory was shifted by him to Almora. Researches here are directed to provide sustainable agricultural development to the region. The innovative application of farm technologies including the plastics in resource conservation agriculture for water harvesting and protected cultivation has brought higher productivity, profitability and sustainability; and at the same time reduced drudgery of farm women in the hill agriculture.

**Dr. Nirmal Chandra** is a Principal Scientist at ICAR- Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora. He has long experience of implementing farming system research projects pertaining to mountain agriculture. He has also worked for long time developing Sustainable Rural Livelihood Systems for different farming situations in hills. He has to his credit a number of research paper in national and international Journal . He has a brilliant academic and research carrier. He has been recipient of ICAR fellowships and various research paper awards.

**Dr. A. K. Srivastva** one of the senior most agricultural scientist is from the 1st Batch of Agricultural Research Service (1976) of ICAR. He completed his studies from the University of Allahabad. A pioneering scientist in Resource Management and Integrated Farming Systems in NW Himalaya and major ecosystems, he as Director, Head and Team Leader at VPKAS, Almora, he led the innovations in integrated farming system including use of plastic for water harvesting and protected cultivation. The resultant diversification to high value crops brought prosperity to hill farmers in NW Himalaya.

**Dr. S.C. Pandey** is working as principal scientist in Soil physics and soil water conservation in ICAR-VPKAS Almora.He developed technologies for water harvesting, runoff farming spring recharging techniques, suitable poly tunnels, vermicomposting, and refinement in drip system to be easily adopted by hill farmers. He published paper in national and international Journal, book chapters and a book. He is recipient of ICAR Team award in natural resource management 2007-2008, Gold medalist for best paper 2004, Best paper award 2009. First prize for oral presentation 2009, Best poster award 2014, Best paper, award 2014.

ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora

## POLYMERS IN AGRICULTURE AND WATER CONSERVATION

"Use of Plastics for Sustainable livelihood Security in Champawat district of Uttarakhand "

**Dr. Nirmal Chandra, Dr. A. K. Srivastva & Dr. S. C. Pandey**

At ICAR-VPKAS, Almora use of plastics in sustainable rural livelihood security project presented a successful model of development for Uttarakhand hills. Integration of plastic based technologies in production systems i.e. drip irrigation system in crop and vegetable production in protected and open condition, use of poly-sheets/ poly-bags for silage making, packaging material in value addition, LDPE water tanks for fisheries, shading material in vermi-composting etc. were very successful. Various technologies which were found beneficial to the farmers were as following –

- Water conservation through LDPE filmed lined tanks coupled with vegetable production gave a boost to rural economy. Micro-irrigation System proved 60% better utilization of conserved water. Three vegetable crops along with commercial papaya/ banana production was possible as compared to poor grain crops
- Use of LDPE Film for Vermin-composting was very successful.In normal course farmyard materials take about 6 months to get fully decomposed. For good growth of earth-worms, shade and regular watering to maintaining good moisture is very essential. Water is in general a scarce commodity in hills. One of the modifications made in the traditional structures was the use of polyethylene film as a roofing material.
- LDPE sheet was used for making huts to grow mushroom.
- Women groups were engaged in food processing activities i.e. production of products like jam, jelly, pickles and juices the packaging materials used were mostly plastic based.
- Blacksmiths were trained in making small farming tools and implements. Plastic pipes were used for good grip and to make the equipments light weight.
- Fisheries provided additional income to the farmers. Conserved water in poly-tanks was used for fish rearing. From each tank farmers got an income of Rs. 8000/- per annum. Common-carp and grass-carp were found to be the most suitable in stagnate water.

**Shri Primal Oswal**
Managing Director

**Harvel Agua India Private Limited** is a 50:50 Techno-Commercial joint venture between HARVEL IRRIGATIONS PRIVATE LIMITED – INDIA, a well-recognized name in Irrigation Engineering since 1984 having world-wide affiliation with irrigation majors and SISTEMA AZUD – SPAIN, a European major in Irrigation & Filtration Systems, part of Wind group of Spain engaged in research, manufacturing and commercialization of high performance agricultural products and services for the past more than 25 years.

The thrust behind conceptualization of the innovation is team HARVEL AGUA led by **Shri Primal Oswal** Managing Director of the company, an Honours graduate from St Stephens College, University of Delhi (DU) with Post Graduate qualifications from Faculty of Management Studies (FMS). Shri. Oswal, with over 3 decades experience in starting up, developing and successfully running an irrigation company, travels worldwide to elicit information on new developments in irrigation and allied fields and keep himself abreast with the latest management trends by attending various modules and courses offered by advanced management institutes like IIM, Ahmedabad and ISB, Hyderabad.

**Shri Primal Oswal's** many achievements include, among others, co helming HARVEL, which has the distinction of innovating and being the first in the country to introduce "PE Pipes based Sprinkler Irrigation equipment", in a market which was then wholly dominated by "Aluminium Pipes based" Sprinkler System. Later Mr Oswal helped HARVEL achieve the status of probably being the only company in the country catering to all four major irrigation industry segments viz; Agriculture, Golf, Turf and Home & Garden irrigation. In recognition of his active involvement in the affairs of irrigation industry, his industry peers elected him as President of Irrigation Association of India, a position he holds for the past 2 years.

HARVEL AZUD
RESPONSIBLE WATER RESOURCE MANAGEMENT

**M/s Harvel Agua India Private Limited,**
**New Delhi**

## POLYMERS IN AGRICULTURE AND WATER CONSERVATION

"Gravity Drip Kit"

**M/s Harvel Agua India Private Limited, New Delhi**

India despite being an agrarian society have been very slow in adopting and leveraging technology to increase farm output, primarily because majority of its farmers are **'Bottom of the Pyramid'** small and marginal peasants with meagre holdings which in most cases means a few hundred square meters tracts of unyielding land. Irrigating the fields in the absence of monsoon remains the biggest impediment for farmers - small or big - but while farmers with large landholdings can optimize scarce water resources using technology and also avail governmental assistance for the same, the small/marginal farmers is unable to do so because of constraints like small land area, no electricity connection, non-availability of electricity etc. **HARVEL's** pioneering **"usage innovation"** lies in developing a modern and highly efficient Irrigation System which is ideal for irrigating fields of 20 to 2000 Sq. Meters and is also affordable by small and marginal farmers who are neither eligible for government assistance owing small size of their land nor are able to make heavy initial investment, being poor. **The Gravity Drip Kit** is not dependent on electricity for operation but uses gravity as a prime mover overcoming the major hurdle of absence of Electricity. These "Do It Yourself" Kits are easy to install, are virtually maintenance free and offer considerable 'cost benefit ratio' against minimal investment. Importantly they lead to better income generation among small farm units and therefore help in poverty alleviation and perpetuate food security among marginal farming communities.


Prof. Anup K. Ghosh


Prof. Naresh Bhatnagar


Dr. M. H Alaei


Shri R. Kumar


Prof. P Mahajan


Ms. P.Singh

**Prof. Anup K. Ghosh** is presently the Head of the Centre for Polymer Science and Engineering, IIT Delhi and had been Associate Dean, Industrial Research & Development at IIT Delhi (2009-2010). He obtained M.Tech degree in Chemical Engineering from the Indian Institute of Technology, Kanpur, India (1982) and a Ph.D in Chemical Engineering from the State University of New York at Buffalo, NY, USA (1986). He worked as a Post Doctoral Research Fellow at the University of Pittsburgh, USA and joined the Indian Institute of Technology, Delhi in 1991. His research interest includes rheology and processing of polymers, reactive extrusion, polymer blending and alloying, nanocomposites, microcellular polymers, biopolymers and polymer reaction engineering. He has authored more than 90 journal articles, 60 conference papers, one book chapter, and is a co-inventor of 9 patents. Seventeen students have completed their Ph.D. under his supervision and he has supervised 80 M. Tech theses. He is a recipient of Young Alumnus Award of Chemical Engineering Department, Calcutta University and Meritorious Service Award of Indian Plastics Institute, India. Prof. Ghosh has served as a member of various prestigious committees and editorial boards of international Journals. He is Member of NASI, International Representative of the Polymer Processing Society, USA and Fellow of Indian Plastics Institute.

**Prof. Naresh Bhatnagar** completed his PhD in 1992 from IIT Bombay and worked in Industry FIAT Auto before joining academics. Being the originator of research in the area of "Machining of Composites" at IIT Bombay in the early 1990's, which is still considered relevant to the growth of future defect free reliable structural products of FRP composites be it in aerospace or automotive applications. Last 15 years at IIT Delhi have also seen him venturing into multidisciplinary research in areas of polymer material processing, leading to products, biomedical implants, biomaterials, nano composites, microcellular injection moulding, microcellular extrusion of porous plastic sheets and new ways of testing and characterization of polymeric composites and related manufacturing technologies. He has supervised 14 PhD- 13 ongoing, 65 Masters Thesis – 6 ongoing in variety of areas related to materials, manufacturing and medical devices. He has published 60+ International peer reviewed journals and 80 in international conferences. He is an active reviewer of several interdisciplinary international journals. He was the coordinator of SAE club of IIT Delhi for the past 7 years: Head, Central Workshop and Central Manufacturing facilities for 3 years and now sharing the responsibility of Associate Dean (Research & Development) of the Indian Institute of Technology Delhi.

**Dr. Mohammad Hossein Alaei** completed his M.Tech (2009) and PhD (2014) from IIT Delhi in the area of Nanocomposites under the supervision of Prof . Naresh Bhatnagar, Mechanical Engineering Department, IIT Delhi under the supervision of Prof. Mahajan.

**Shri Ranjeet Kumar** is assistance professor at Indian Spinal Injuries Centre, New Delhi. Currently, he is doing Ph.D from Indian Institute of Technology, Delhi

**Prof. P Mahajan** completed his Ph.D in Mechanical Engineering, with a Minor in Mathematics. Montana State University, Bozeman, Montana, U.S.A. June '90. He is Professor at IIT, Delhi. He is doing research in helmets, mechanical behavior and impact of composites, applications of finite elements, snow mechanics. He was Visiting Faculty of Institute of Low Temperature Science, Sapporo, Japan. He has developed a modified shear lag model to study the effect of reaction zone on stress concentration in fibres in metal matrix composites.

**Ms. Priyanka Singh** completed her M.E. from Delhi college of Engineering, Delhi and worked as a research team in Machine Innovative Research and Application Centre (MIRAC) of Machine polymers ltd. She has submitted her Ph.D thesis in Nov 2014 from Indian Institute of Technology Delhi under the supervision of Prof. A.K. Ghosh, IIT Delhi.

Indian Institute Technology, Delhi

## POLYMERS IN PUBLIC HEALTH CARE

"Multi-Functional Polymeric Orthotic Knee Joint for Polio and Cerebral Palsy Patients"

**Prof. Anup K. Ghosh, Prof. Naresh Bhatnagar, Dr. M. H. Alaei, Shri R. Kumar, Prof. P Mahajan & Ms. P. Singh**

The present invention is related to the development of a polymeric orthotic knee joint with drop lock device or gravity operated locking device, which can sustain the large compressive and flexural loads experienced by orthotic braces and is affordable for all classes of the community. Orthotic knee joints are used by amputees and patients of poliomyelitis. Currently, such joints are made of metals. However, the weight of a metallic joint is 300 g. The primary objective of developing a polymeric orthotic joint was weight reduction, in order to lower the energy required by the patient during walking. Going from metal to polymer in this application was a big challenge since polymers do not have the same strength and modulus as steel. Especially in orthotic joints, where big stress concentrations take place, the team had to take additional steps to prevent torsional stresses that may arise during use. In addition, in order to prevent stress concentration in the hinge, an offset is provided, which is not in the case of the existing designs. The design has the flexibility to be used either in 'Offset' mode or 'Drop Lock' mode, depending on the requirement of the patient. The hinge can sustain a compressive load of more than 400 kg and flexural load of 50 kg.

The team designed, modeled and analysed a number of designs for orthotic knee joint which have been applied for field evaluation. Many polymeric blends were studied for good combination of tensile strength, flexural strength, fatigue strength and abrasion resistance. Finally a blend of polycarbonate (PC) and Acrylonitrile Butadiene Styrene (ABS) was selected. The knee joint was produced by injection moulding process, a process which is commercially viable and has high production rate. This was trial evaluated and results are very encouraging. The final weight of the hinge joint is 50g. Also, the cost is Rs. 60/-, thereby making the device not only lighter but also much more affordable than the existing metallic joint which costs Rs. 400/-. The universal orthotic knee joint is likely to benefit approximately 10 million physically challenged people of this country.



**Team - Prof. Anup K. Ghosh Prof. Naresh Bhatnagar, Prof. P Mahajan, Dr. M.H Alaei, Shri R. Kumar & Ms. P. Singh is the WINNER of National Awards 2014-15 under the Category of "Polymers in Public Health Care"**

**Dr. M Ayyappan**

**Dr. Jagan Mohan A Tharakan**

**Dr. M. Ayyappan,** Chairman & Managing Director, HLL Lifecare Limited. Joined HLL in 1991 as Head Marketing, Dr. Ayyappan was instrumental in setting up a World class Marketing infrastructure. Dr. Ayyappan has been at the helm of affairs at HLL since 2003. Under his dynamic leadership HLL has metamorphosed from a "Condom Company" to an "Integrated Healthcare Delivery Company".

He founded three institutions that have the potential to change the healthcare delivery scenario across the globe. He founded the "Life Spring Hospitals" (JV with Acumen Fund, USA) a chain of maternal care hospitals that offers high quality maternal care at affordable rates. He is also the chairmen of Hindustan Latex Family Planning Promotion Trust-one of the largest Social Marketing Organizations in India today.

Recently HLL gave birth to HLL Biotech Ltd (HBL), a state-of-the-art WHO-pre-qualified vaccine manufacturing facility at Chengalpet, near Chennai. HBL, a project of national importance, aims to boost India's vaccine security with an uninterrupted supply of vaccines at affordable prices.

Dr. Ayyappan holds his doctorate degree in "Social Marketing" from University of Kerala & is a fellow of All India Management Association and has a deep passion for research and teaching. He is a mentor and teacher to the budding managers, academics, corporate and is a most sought after speaker by academic institutions.

**Prof. Jaganmohan A. Tharakan,** a cardiologist by profession who is the motivating force behind all technology developments in the Institute Dr.V. Kalyana Krishnan, the Principal Investigator of the EMILY Project is a senior scientist & heads the Dental Products Laboratory of the Biomedical Technology Wing of SCTIMST. He took his doctorate in Biomaterials Science & Technology from SCTIMST. He carried out his postdoctoral work in University of Liverpool, UK. India is emerging very fast as the most populous country in the world next only to China.

Currently the Institute is headed by Sree **Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST),** Trivandrum is an Institute of National Importance with the status of a University under the Department of Science and Technology, Govt. of India. The Institute focuses on patient care of high quality, technology development of industrial significance and health research studies of social relevance

HLL Lifecare Limited
(A Government of India Enterprise)

Sree Chitra Tirunal Institute for
Medical Sciences and Technology (SCTIMST),
Thiruvananthapuram

## POLYMERS IN PUBLIC HEALTH CARE

"An Intrauterine System (IUS) with Controlled Drug Delivery"

**Dr. M Ayyappan & Dr. Jagan Mohan A Tharakan**

The Levonorgestrel Intrauterine system (Trade name **'Emily'**) was jointly developed by HLL Lifecare Ltd, Trivandrum, Kerala and Sree Chitra Tirunal Institute of Medical Science and Technology (SCTIMST), Trivandrum, Kerala. The developed IUS is an affordable Levonorgestrel Intrauterine System (IUS) with an innovative shape that allows it to be placed inside the uterus without an inserter device. Further, a clinical study was conducted in women suffering from Dysfunctional uterine bleeding and was shown to be highly efficacious. This product resulted in an affordable worry free option to a large population of women suffering from DUB and a smart option for long-term reversible contraception for a period of 5 years.The device consists of three major components: 1) A 'M' shaped flexible plastic which holds the medicated drug reservoir and its drug regulating membrane, 2) A drug reservoir which is a room temperature vulcanizing siloxane-based elastomer impregnated with Levonorgestrel and 3) Regulating membrane which is reinforced siloxane-based elastomer. Levonorgestrel is incorporated on to the elastomer using shear mixing for a prolonged period and moulded using appropriate moulds onto desired shape. Regulating membrane is fabricated using siloxane-based elastomer incorporated with reinforcing filler. The In vitro release of Levonorgestrel from the device, was studies in Simulated Uterine Fluid (SUF). The mechanism of controlled release of the drug is attributed to the unique property of silastic membranes which allow the diffusion of the body fluid into the drug reservoir to dissolve the drug creating an osmotic pressure within the drug reservoir and thus diffusing the dissolved drug to the uterus through the membrane micropores. The membrane is designed to release Levonorgestrel at a constant dose of 20µg per day.The device has shown comparable clinical performance in the management of DUB. The treatment resulted in the improvement of quality of life of the women who completed the study. The device has got an innovative M-shape which enables it to be placed in the uterus without the need of an inserter device which makes it cost effective and affordable to most patients.

Hence development of a highly effective, safe and relatively inexpensive method of contraception gains importance. One such device is the intrauterine device (IUD) which is a small plastic T-shaped device that is inserted into the uterus. An IUD's contraceptive action begins as soon as the device is placed in the uterus and stops as soon as it is removed. IUDs have an effectiveness rate of close to 100%. IUDs provide protection against pregnancy comparable to that provided by female sterilization. Development of a constant drug releasing intrauterine device which can last for 5 years without removal and very effective in its function was taken up by SCTIMST and HLL Lifecare, Trivandrum jointly in 2006 and currently this product based on a drug releasing polymer has entered the market under the brand name Emily. Work started in the collaborative project in 2007 and was completed in 2011. Thanks to the co-operation meted out by all supporting staff and co-investigators, various developmental stages like processing, fabrication and standardization of the constant drug release polymer system; physicochemical, cyto-toxicity and in vivo evaluations were all carried out in a systematic manner. The team enjoyed the cooperation of the industry partner (HLL Lifecare) at all stages who developed the T-support of the device. Monitoring the progress of the project was carried out at regular intervals jointly. Dr.V. Kalyana Krishnan and his group has been instrumental earlier in development of a number of medical products such as blood bags, dental composites, bonding agents, caries dissolving agents, etc. and successfully transferred these technologies to industry.

**Team - Dr. M Ayyappan & Dr. Jagan Mohan A Tharakan is the JOINT RUNNER-UP of National Awards 2014-15 under the category of "Polymers in Public Health Care"**


Shri Anirban Roy


Dr. Sirshendu De


Dr. Lloyd Vincent


Dr. Shyam Vasudeva Rao

**Shri. Anirban Roy** completed his undergraduate training in Chemical Engineering from Heritage Institute of Technology, Kolkata, in 2007 and Masters in Chemical Engineering from Jadavpur University, Kolkata in 2009. He had a brief stint as a research assistant at the University of Rhode Island from 2009-2011 and worked as a consultant engineer at M.N. Dastur and Co Pvt. Ltd for TATA Steel, Jindal and Vizag steel. He joined the PhD program at Department of Chemical Engineering, IIT Kharagpur, under the guidance of Prof. Sirshendu De, in 2012 and has been working on membrane separations with specialization on hemodialysis membranes. He is involved in developing the indigenous process design of hemodialysis grade hollow fibers as topic of his PhD dissertation. He has published 7 papers in international journals and has 3 international and 4 national conference publications. He has also filed 3 patents and has received the "Young Innovator of India 2015" award in the Make In India conclave held at IIT Bombay. His research interests include biomedical applications of membrane technologies, polymer blend thermodynamics, rheology and clarification of food products and water treatment.

**Dr. Sirshendu De** is professor of Department of Chemical Engineering, Indian Institute of Technology Kharagpur (IIT KGP). He completed his undergraduate (1986-90), masters (1991-92) and PhD (1993-1997) degrees all from IIT Kanpur. Having completed his PhD he joined IIT KGP as Assistant Professor in 1997 and rose to Associate Professor in 2002, finally becoming a Professor in 2007. Presently he is the Head of Department of Chemical Engineering. Prof. De is an eminent chemical engineer in India. He maintains national and international visibility through his innumerable international publications (205), patents (15), books (7) and book chapters (10) and 3 technology transfers. Apart from developing low cost spinning of both dialysis membranes as well as hollow fibers for water treatment and other industrial use, some of other innovations by Prof. De include ultra low cost filter for removal of arsenic from drinking water, extraction of polyphenols from green tea leaves and processing of packaged tender coconut water with high shelf life without any additive and preservative. Prof. De has been awarded with prestigious Shanti Swarup Bhatnagar (2011), NASI Reliance (2013), Herdilia Awards (2010) etc. He is a fellow of INAE and NASI.

**Dr. Lloyd Vincent** is a Senior Consultant Nephrologist and Clinical Director of the Dialysis services at the Narayana Hrudayalaya Hospitals and Satellite centres, Bangalore, India. He completed his undergraduate from St John's Medical College, Bangalore and MD in internal medicine from the Kasturba Medical College, Manipal. He completed DM in nephrology, from the Christian Medical College (1995). He got a Masters Degree in Medical Informatics from The Erasmus University Rotterdam, Netherlands (2001) and Masters Degree in Healthcare Administration from the University of Toronto (2009). Dr Vincent has been recipient of prestigious fellowships and awards like International Society of Nephrology Fellowship (1999), American Society of Transplantation (2007), CHE degree and Marc Goldstein Clinician of the year award (2005). He is currently an accredited Canadian Healthcare Executive and an assessor with the National Accreditation Board for Hospitals and Healthcare Providers (NABH).

**Dr. Shyam Vasudeva Rao** is the Managing Director of **Forus Health Pvt Ltd.** He did his engineering and masters in Electronics from SJCE, Mysore University and PhD degree from IISc Bangalore. He has worked at Ericsson and as a Director of technology in Philips Innovation Campus, Bangalore. He has been serving as member Board of Governance and academic council of several reputed institutions like SJCE Mysore, PES Institute of technology etc. and board of studies at MSRIT, BMS etc. and visiting faculty at MIT Manipal and BMS engineering college. He has won IISc gold medal and Prof. Badkas best thesis award. His innovation 3nethra has won several awards like DST Locked Martin Gold medal, Perimal Award, Sankalp Award, CNBC TV18 Award, Samsung Innovation Quotient Award, NASCOM Innovation Award and Anjani Mashelkar Inclusive Innovation Award for 2011. He has published more than 40 technical papers and filed more than 20 international patents.

IIT- Kharagpur,

Renalyx Health Systems Private Ltd

Bangalore & Forus Health Pvt. Ltd,

## POLYMER IN PUBLIC HEALTH CARE

"Development of Indigenous low cost Haemodialysis Cartridge"

**Shri Anirban Roy, Dr. Sirshendu De, Dr. Lloyd Vincent & Dr. Shyam Vasudeva Rao**

Hemodialysis is administered to patients who suffer from kidney malfunction / failure. The primary job of the kidneys is to reject the uremic toxins, viz. urea and creatinine from the body. Kidney failure results in building up of these uremic toxins which need to be cleared from the body, else the patient loses life. The most conventional method adopted is through a hemodialysis cartridge fitted outside the body. This cartridge has clinically specified ultra thin hollow fiber membranes. These membranes filter the blood of uremic toxins. The clinical specifications of the membranes are 180-230 microns inner diameter and thickness of 35-50 microns. 7000-15,000 of such membranes are packed in a dialyzer cartridge. This yields an area of 1.1-1.5 m2 and also minimizes the dead volume of the cartridge to around 80-90 ml. Such a cartridge, once employed, takes around 3-3.5 hours to purify the total volume of blood in the human body. A person suffering from very severe kidney failure requires about 3 such sessions every week to stay healthy and thus 3 cartridges are required every week, one for each session. Focal point of the problem lies in manufacturing of these membranes. Worldwide, there are five to seven manufacturing houses that have the capability of manufacturing (called spinning) these membranes The technology employed by each of them is patented and broadly involves using a spinneret. These spinnerets are very expensive items (Rs. 18-30 lakhs) and moreover, are custom made and patented. This is the reason why dialysis membranes are not manufactured in India and hence all our cartridges are imported. The present innovation involves the development of a complete indigenous technology to spin such fibers. These fibers match the clinical specifications of Fresenius (German) company, a market leader, having an internal diameter of 220 microns and thickness of 35-40 microns. Fundamental flow behaviour and rheology of polymers in expensive spinnerets have been understood to mimic the spinneret design. This indigenous technology does not involve any expensive spinnerets, or imported equipment. Nor does this technology involve any sophisticated machinery. The invention uses disposable syringe assemblies (Rs 20), fabricated in the lab and a complete indigenous process design to spin dialysis grade fibers. This developed process does not involve any prime moving devices like pumps and utilizes minimum energy. All these factors, combined, make this technology ultra low cost and hence the fibers and cartridges are projected to cost around half of what is available in the market. The developed process has been filed for an Indian patent and is in process for a US patent. This technology, along with intelligent combination of already reported biocompatible polymer blends, has been utilized by the inventor to spin dialysis grade hollow fibers of various grades (high efficiency, high performance, high cut-off) which are available in the competitive market.



**Team - Shri Anirban Roy, Dr. Sirshendu De, Dr. Lloyd Vincent & Dr. Shyam Vasudeva Rao is the JOINT RUNNER-UP of National Awards 2014-15 under the of "Polymers in Public Health Care"**

**Shri Dilip G. Parimal**
Chairman

**Shri Anit Asthana**
Managing Director

**Electrowater Technologies Pvt. Ltd** has developed 3 unique patented technologies which make the machine very economical(MRP 21000 and 24000) and use only 0.6 to 1.2 units per liter and also work in 10% humidity levels (minimum) This can solve the drinking water problem of the country and alleviate untold misery of millions of Indian households.

The Managing Director of the company is Shri. Anit Asthana (B Tech from IIT ,Delhi and MBA from XLRI) who has 7 other patents in his name .He has developed many other low cost and unique products The Chairman of the company is Shri. Dilip Piramal a large industrialist who has set up many industries with a successful track record of innovation and brands developed for the Indian market like VIP Industries, Moderna Furniture, Klober Systems etc.

Paradis

**M/s Electrowater Technologies Pvt. Ltd., Mumbai**

## POLYMERS IN PUBLIC HEALTH CARE

"Device for Making Water from Atmosphere"

**M/s Electrowater Technologies Pvt. Ltd., Mumbai**

There is an urgent need in the country for alternative sources of pure drinking water as population grows and fresh water resources become scarce. A number of infant deaths occur due to this and a large number of man days are also lost due to avoidable water borne diseases and not to mention human misery. The answer to this problem is to generate pure drinking water from the atmosphere by tapping the humidity always present in the air. India is blessed with a vast coastline ensuring a high percentage of humidity in all areas (even in the the desert and mountain areas).

The state of the art for such machines is in USA and Australia and Israel which have developed such machines but are very expensive(lacs of rupees),and also consume power up to 2 to 3 units per liter and do not work in less than 50% humidity levels making them very special purpose machines for limited end use.

Dr. S. Ananda Kumar

Shri D. Duraibabu

Shri P. Saravanan

Shri Yiheyis Bogale Zemede

**Department of Chemistry, College of Engineering, Guindy campus, Anna University, Chennai** is amongst the most active research departments in Anna University. It was established in the year 1975 to pursue teaching, research and consultancy and to impart training programmes in different fields of Chemistry. Since its inception, the department offers core courses in **M.Sc** (Applied Chemistry), **M.Tech** (Polymer Science and Engineering), **M. Phil** (Chemistry) and **Ph.D** programs.

**Dr. S. Ananda Kumar Senior Grade Assistant Professor of Chemistry, Anna University, Chennai,** is an Excellent Team Leader. He is resourceful & innovative and he has proven talent to adapt quickly to challenges, with a "Never give up" Attitude. He is trustworthy, honest, quick learner and a meticulous worker. He possess positive attitude with a very pleasant personality matched with the ability to manage stress, time and people effectively. He specializes in the field of nano hybrid coatings and composites. He also received an **Active Researcher Award of Anna University** for the **year 2014 from Dr. A.P.J. Kalam** (His Excellency former President of India).

**Shri D. Duraibabu** an Indian Ph.D. student of **Dr. S. Ananda Kumar.** His main focus of research was on fabrication of **skeletally modified tetraglycidyl epoxy nanocomposites.** He was a recipient of UGC Fellowship (2011-2015).

**Shri P. Saravanan** an Indian (PT) Ph.D scholar of **Dr. S. Ananda Kumar.** He works as Assistant Professor in **St. Joseph's College of Engineering, Chennai.** He works on **"functionalized nanoparticles loaded epoxy antifouling coatings".**

**Shri Yiheyis Bogale Zemede** an Ethiopian student registered for PhD in Anna University through ICCR in the Department of Chemistry. He works as Lecturer of Chemistry in **Haramaya University, Ethiopia.** Currently he is working on **"Synthesis, characterization, and antimicrobial studies of new Schiff base metal complexes".**

**Department of Chemistry**
**Anna University, Chennai**

## RESEARCH IN THE FIELD OF POLYMER SCIENCE & TECHNOLOGY

"Nano Hybrid Coatings and Composites"

**Dr. S. Ananda Kumar, Shri D.Duraibabu, Shri P. Saravanan & Shri Yiheyis Bogale Zemede**

India alone loses around **2 lakh crores** annually due to **corrosion.** Another costliest problem encountered by a wide spectrum of technical systems, ranging from the shipping and power industry to water purification, automobile industry, paint and pharmaceuticals, to the microelectronics and food industries is fouling. This leads to excessive biocide use to kill biofouling that cause equipment damage and environmental pollution. An ideal method for preventing these problems is by coating. Hence we focused our research on developing coatings with inherent antifouling properties thereby eliminating the need for toxic biocides. Effects of natural anti fouling agents such as champaka leaves and certain **Nano Hybrid Materials** as alternative anti-corrosive coatings were also explored. Further, large number of death occurs **globally** due to **fires.** Flame retardants currently in use cause brain and neurological damages in humans. Thus we explored novel avenues to alternate them with non-halogenated one.



**Team - Dr. S. Ananda Kumar, Shri D.Duraibabu, Shri P. Saravanan & Shri Yiheyis Bogale Zemede is the JOINT RUNNER-UP of National Awards 2014-15 under the Category of "Research in the field of Polymer Science & Technology"**

Dr. Rajeev Mehta

Ms. Shilpa Narang

Dr. S.N. Upadhyay

**Dr. Rajeev Mehta** is presently working as Professor at Department of Chemical Engineering, Thapar University Patiala (Punjab). He completed his B.Tech from IIT Delhi (1987) and MS in Chemical Engineering (May 1989) from Virginia Polytechnic Institute & State University, Blacksburg, VA, USA and PhD from Thapar University Patiala. His research interest includes Polymers synthesis, polymer processing, Fibre reinforced polymers and polymer nano-composites.

**Miss Shilpa Narang** completed her Masters in Chemical Sciences (2010) from Thapar University Patiala. She is presently doing her PhD at Thapar University. She is working under the supervision of Prof Mehta and Prof Upadhyay. Her research area includes polymer synthesis and synthesis of organometallic complexes.

**Prof. S. N. Upadhyay** graduated from the Banaras Hindu University in 1964 and obtained his Ph.D. (Chem. Eng.) degree from the same university in 1969. Professor Upadhyay has widely traveled. Prof. Upadhyay has made significant contributions to the fields of heat and mass transfer in fixed and fluidized beds, non-Newtonian fluids, heterogeneous catalysis, industrial pollution control, waste utilization, bio-sorption, biodegradation of xeno-biotic compounds, bio-compatible and biodegradable polymers and many more.

M/s Thapar University, Patiala

IIT - BHU, Varanasi

## RESEARCH IN THE FIELD OF POLYMER SCIENCE & TECHNOLOGY

"Chemical Fixation of Carbon dioxide and Propylene Oxide to Poly (propylene carbonate) and Cyclic Carbonate"

**Dr. Rajeev Mehta, Ms. Shilpa Narang & Dr. S. N. Upadhyay**

One of the better means to reduce CO2 emission is to use CO2 as a starting material in chemical reactions that not only fix CO2 but also give value added products. Since CO2 is a nontoxic, nonflammable and inexpensive substance, there has been a continued interest for its use as a viable carbon feedstock. Thus the idea of using CO2 in synthetic chemistry is of interest from the perspective of both environmental protection and resource utilization.

There are number of reactions that give value added products with CO2. Amongst the most promising green reactions in this area is the catalytic transformation of CO2 into polycarbonates and cyclic carbonates. The reaction products thus obtained are value added commodities of immense economic importance and utility. The work is an attempt to synthesize cyclic carbonates and Poly(propylene carbonate) from Carbon Dioxide and Propylene Oxide.

**Significance:** The polymeric product Poly(propylene carbonate) is used for increasing the toughness of some epoxy resins, as a sacrificial binder in ceramic industry, in preparation of electroceramics like dielectric materials and piezoelectric ceramics. They are materials with many environmental, biomedical, and pharmaceutical applications. Cyclic carbonates are used for various purposes such as electrolytic elements of lithium secondary batteries, polar aprotic solvent and monomers for synthesis of polycarbonates and chemical intermediates for preparing medicines or agricultural chemicals. Cyclic carbonates are useful and are greener substitutes for toxic phosgene and dimethyl sulfate in many chemical reactions.



**Team - Dr. Rajeev Mehta, Ms. Shilpa Narang & Dr. S.N. Upadhyay is the JOINT RUNNER-UP of National Awards 2014-15 under the Category of "Research in the field of Polymer Science & Technology"**


Dr. Raksh Vir Jasra


Dr. Madhuchhanda Maiti


Dr. Ganesh Basak


Dr. Vivek K. Srivastava

**Reliance Industries Limited** (RIL) is India's largest private sector company with a turnover of US$ 3.9 billion and exports of $44.1 billion. RIL is the first private sector company from India to feature in Fortune's Global 500 list of world's largest corporations. RIL's business is integrated from textiles to fibre, polymers and crude oil.

RIL is the first private sector company from India to feature in fortune's global 500 list of world's top 100 companies ranking 99th in terms of revenues and 130th in terms of profits in 2012. RIL ranks 68th in the financial times 'FT Global 500' list of the world's largest companies. RIL is ranked amongst the '50 most innovative companies-2010' in the world in a survey conducted by the US financial publication-business week in collaboration with the Boston Consulting Group (BCG). In 2010, BCG also ranked RIL as the second highest 'Sustainable Value Creators' for creating the most shareholder value over the decade in the world.

**Dr. Raksh Vir Jasra,** FNAE, Ph.D. from IIT, Delhi has research experience of 34 years in the area of chemicals and petrochemicals. He joined Reliance Industries Limited as Head of Research and Development Centre, Vadodara which is focused on petrochemicals research.

**Dr. Madhuchhanda Maiti,** M. Tech., Ph.D. from IIT, Kharagpur has research experience of 10 years in the area of Polymer Science and Technology. She is presently working as Senior Manager in the Research and Development Centre, Vadodara focusing on elastomer research and product development.

**Dr. Ganesh Basak, M. Tech.,** Ph.D. from IIT, Kharagpur has research experience of 8 years in the area of Polymer Science and Technology. He is presently working as Manager in the Research and Development Centre, Vadodara focusing on elastomer research and product development.

**Dr. Vivek K. Srivastava,** Ph.D. from CSIR-CSMCRI, Bhavnagar has research experience of 10 years in area of chemicals, catalysis and petrochemicals. He joined Reliance Industries Ltd. in 2008 as Research Scientist at Research Centre, Vadodara which is focused on Petrochemical research.

Reliance
Industries Limited

**M/s Reliance Industries Limited, Mumbai**

## RESEARCH IN THE FIELD OF POLYMER SCIENCE & TECHNOLOGY

"Intrinsic Self-Healing Poly Butadiene Rubber and its Blend"

**M/s Reliance Industries Limited, Mumbai**

The shelf-life, reusability and dumping of waste-tire are at present major economic and environmental concerns and a major challenge for the industries. The management of scrap tires has become a growing problem in recent years. Stockpiles of scrap tires are located in many communities, resulting in public health, environmental, and aesthetic problems. The self-healing elastomer (SHE) seems to be a potential solution of the said challenges. The developed SHEs based on high-molecular weight tire-grade rubber have the ability to mend themselves automatically. In turn, these can increase the product life-cycle. Moreover, as the said self-healing elastomer is developed using high-molecular weight tire-grade rubber, therefore has high potential of commercial success.

The principle involved in the developed SHE is intrinsic. It can be prepared using conventional rubbers and rubber-chemicals as well as processing equipment. The SHE-1 shows recyclability up to 10 times without loss in mechanical properties as well as self-mending properties which could be a potential material for gum rubber applications like window seal, roofing etc. Furthermore, the SHE containing blend, SHE-2 shows significant improvement in properties in terms of mechanical, ageing and fatigue to failure in comparison to standard formulated rubber blend used in tire industries. The introduction of self-healing concept in commercial grade rubbers not only widens versatility but will certainly open up a new horizon to the rubber world

**M/s INDIAN OIL CORPORATION LTD.**
R&D Centre, Faridabad, Haryana, India

**Indian Oil Corporation Ltd.** is India's largest company by sales with a turnover of Rs. 4,57,553 crore and profit of Rs 7,019 crore for the year 2013-14. Indian Oil is the highest ranked Indian company in the latest Fortune 'Global 500' listings, ranked at the 96th position.

Indian Oil has a sprawling world-class R&D Centre that is perhaps Asia's finest. This Centre is India's foremost commercial centre of research excellence in the areas of lubricants, refinery processes, pipeline transportation, alternative fuels fuel additives, engine testing, materials sciences, environmental sciences, nanotechnology, petrochemicals & polymers. The Centre holds 304 active patents, including 162 international patents. The Petrochemical and Polymer wing of IOC-R&D is equipped with state of the art facilities to carry out any challenging research work in the area of Ziegler-Natta Catalysts, Polymerisation, Post Reactor Modification, Biocomposites, New Grade Development etc.

## RESEARCH IN THE FIELD OF POLYMER SCIENCE & TECHNOLOGY

"Indigenous Catalysts Development for producing Polypropylene using Novel and Low cost precursors - A step towards "Make in India"

**M/s Indian Oil Corporation Ltd., R & D centre, Faridabad**

Indian Oil, **the second largest producer of PP in India,** through its concerted R&D efforts has successfully developed a **novel and economical magnesium based support** which has been extensively and successfully subjected to catalyst synthesis. The synthesis has been based on o**ff-the-shelf available raw materials** making the process viable. The resulting catalyst system was found to be **highly active for propylene polymerization** resulting in polypropylene having desirable isotacticity and excellent control over melt flow index. The polymer formed during polymerization exhibited excellent morphology.

Another noticeable feature of novel catalyst systems is that it is **designed to be drop-in catalyst** thereby not requiring any additional hardware and/or additional steps for utilization in commercial polypropylene production for **direct replacement of currently imported catalysts in the future.**

More important is the fact that the **creation of such type of Intellectual wealth** for the fastest growing commodity polymer which has a huge market in India and countries surrounding will lead to having own catalyst technology and hence fulfills the **"Make in India"** thought process. **This ensures that IOCL as representing India is active not only in technology buying but also recognized on technology development platform.**

**Dr. Mukesh Doble**

**Indian Institute of Technology Madras** (Chennai) is one among the foremost institutes of national importance in higher technological education, basic and applied research (inaugurated in 1959). In 1956, the German Government offered technical assistance for establishing this institute. The Institute has sixteen academic departments and a few advanced research centres in various disciplines of engineering and pure sciences. The department of Biotechnology was formally started in the year 2004.

**Dr. Mukesh Doble** is a Professor in the Department of Biotechnology at IIT Madras, Chennai-600036, INDIA, (Tel: +91-44-22574107, E mail: mukeshd@iitm.ac.in; mukes.doble0@gmail.com; https://biotech.iitm.ac.in/faculty/mukesh-doble/). He has previously worked for 20 years in Imperial Chemical Industries (ICI) and General Electric (GE) Technology centres. His areas of interest are Drug design, Biomaterials , Bioreactors and Bioremediation. He holds B. Tech and M. Tech degrees in Chemical Engineering from IIT, Madras, India and a Ph. D. from University of Aston, Birmingham, UK and postdoctoral from University of Cambridge, U.K., and Texas A&M, U.S.A. He has authored or coauthored 240 technical papers, eight books and filed 7 patents. He is a fellow of Royal Society of Chemistry, London and a recipient of Herdillia Award for "Excellence in Basic Research" from Indian Institute of Chemical Engineers. He is a member of the American and Indian Institute of Chemical engineers.

## RESEARCH IN THE FIELD OF POLYMER SCIENCE & TECHNOLOGY

"Antimicrobial Food Wrap"

**M/s Indian Institute Technology Madras**

With the rapid and increased growth of packed food products, challenges emerge in packaging of food products and retaining their shelf life until they are transported from farm to dining table. Packaged food products can encounter microorganisms that make the food unsuitable for consumption or lead to outbreaks of food-borne diseases. Such microorganisms can originate from the food itself, the food contact surfaces, and/or the surrounding environment. So safety of food products and their shelf life has been a subject of increasing concern. An anti-biofilm and antimicrobial polymer wrap using a food grade enzyme modified polymer film is proposed in this invention. A cross-linker such as curcumin is used here to hold the enzyme to the polymer thereby retaining its activity and stability. The cross-linking is performed with the help of UV and without the use of any harsh or toxic chemicals so that the food is safe for consumption. Since the enzyme and curcumin have antimicrobial properties they prevent the bacteria to grow and extend the shelf life of food. The improved anti-biofilm and antimicrobial polymer film proposed herein can be adapted in a wide variety of food packing applications including, meat products, milk products which are processed or un-processed, fruits and vegetables. These films could also be inserted inside the foods as pads or sachets. This approach can be used to modify any polymer surface.

This is a novel, mild (room temperature and pressure), sustainable, green and broad approach. Currently antibacterial compounds/ antibiotics/sulphur etc are used for preparing such antibacterial films which are toxic. The bacteria may become antibiotics resistant. Use of enzyme as antibacterial can overcome the problems as well as they can act on both gram positive as well as gram negative organisms. The enzyme that is used for immobilising can be isolated from food such as ginger/garlic/papaya and curcumin is used in Indian foods.



M/s Indian Institute Technology Madras is the RUNNER-UP of National Awards 2014-15 under the Academics and R&D Institution Category of "Research in the field of Polymer Science & Technology"

**Shri Vijay Singla**

**IOL Chemicals and Pharmaceuticals Limited** deals in Bulk chemicals & Active Pharmaceuticals, with a turnover of approx Rs 600 cr, company's core competency is that from bulk chemicals its has expended business in forward integration to become independent unit for pharmaceutical products.

Company derive a unique kind of blend business of chemicals and pharmaceuticals and integrated up to a basic chemical stage, to overcome dependency, changing market dynamics, and civil threats and roll out a cost effective end product to its users in domestic and international markets.

IOLCP is an ISO 9001-2008, 14001-2004 & OSHAS 18001-2007 company. In 2008 & 2013 IOLCP has got safety Award. Apart from this company is being honored by National Energy conservation Award successively from 2005-2014 for chemical sector.

Shri Vijay Singla B.Tech Chemical Engg working as Executive Director in M/S IOL chemicals and pharmaceuticals Limited. He has 15 years Rich and hardworking experience in, technological innovation, Designing, Implementation and operation of Green Field projects in Petro-Chemicals, Alcohol Based Chemicals, and Chloride based Chemicals and Active Pharmaceuticals, Co-generation, Technology Up-gradation, Process re-engineering and Energy Saving Projects.

IOL Chemicals and Pharmaceuticals Limited

**M/s IOL CHEMICALS AND PHARMECEUTICALS LIMITED**
Trident Complex, Mansa Road, Barnala (Punjab) 148101, India

## INNOVATION NOT COVERED UNDER SEVEN CATEGORIES

"Dual Technology for Synthesis of Mono Chloro Acetic Acid & Acetyl Chloride Using Green Chemistry"

**M/s IOL Chemicals and Pharmaceuticals Limited, Barnala**

In Synthesis of Mono chloro acetic acid (MCA) either $H_2SO_4$ is used as catalyst otherwise process suffers with a major drawback of HCl as a byproduct, moreover In case of acetyl chloride all the processes available are using thionyl chloride or $PCl_3/PCl_5$ as catalyst in stochiometric ratio, which will lead to hazardous byproducts.

Innovation at IOLCP has done by developing a Dual technology in which one molecule of acetic anhydride & chlorine are used from outside to generate one molecule of acetyl chloride & one molecule of mono chloro acetic acid, whereas acetic acid & HCl generated in-situ are used within reaction, with no generation of any waste or hazardous material. Hence 100% atom economy is achieved & it is a totally green process.

MCA & Acetyl chloride are the most important halogenated derivatives of acetic acid, undergo various reactions to form number of Chemical intermediates, Agrochemicals (Herbicides, Pesticides), Bulk drug Pharmaceuticals etc. Both the chemicals are used in multi tons & consumption of these two chemicals is increasing day by day.

**Shri Vineet Mital**

**Tanishka Products** is a partnership company promoted by alumni from Purdue University & IIT Delhi. It is focused in providing to its clients & customers industry leading product delivery using microencapsulation/ nano-fabrication techniques. Tanishka Products has demonstrated certified and consumer perceptible innovations in Fragrance, Antibacterial, Antifungal & Pesticide systems. It regularly provides solutions on a commercial scale in Textiles, FMCG, Paints & Pesticide industry.

**Shri Vineet Mital** in-charge of technical innovation at Tanishka Products has done B.Tech in Chemical Engineering from IIT, Delhi (1990 -1994). Subsequent to this he has worked at prestigious multinational companies like Hindustan Lever Limited India, PZ Cussons Plc UK & IFF USA at various capacities and as leader of global R&D groups. He is the Founder & Director of Innoleague, a technical consulting firm in FMCG industry and the Founder & Managing Director of Tanishka Products. His skills are in establishing science and technology based startups in the service industry and manufacturing industry, lean product development, experience in formulating MVPs (minimum viable product), identifying criteria for pivoting of product design based on initial sales/consumer feedback and bolting on Innovation programs on top of customer/consumer development cycles. His expertise lies in technology development in FMCG systems, fragrance delivery, encapsulation and controlled release technology using various polymers with final application development for the Textile / Leather/Paints/Pesticide & FMCG industry.

TANISHKA PRODUCTS

**M/s. Tanishka Products, Mumbai**

## INNOVATION NOT COVERED UNDER SEVEN CATEGORIES

"Control release through MF Polymer Encapsulation"

**M/s Tanishka Products, Mumbai**

**Significance:**

- Cost efficiency, reduction of environment footprint & customized delivery of actives is the need today. Solutions in controlled release have been very expensive as they have been imported into India
- Tanishka Products has done the basic R&D from first principles and has not only created microcapsules with MF /UF polymers to help in controlled release of various actives but also has done considerable final product development.
- These capsules are immobilized on fabric, hair, paper and hard surfaces. Therefore they provide controlled release of the active without causing toxicity or harm to the users or to the environment. The application itself has better sustainability as the active dosage itself can be reduced due to highly targeted delivery. Natural actives which degrade quickly can be advantageously used in this technique

**Benefits**

- Long lasting/ heat stable antibacterial efficacy from natural oils like citronella, neem oil etc passing military standards. Similar applications for moth repellence using natural oils
- Very efficacious antifungal for technical textiles being used in extremely humid conditions
- Phase Change Materials providing latent heat storage and ease of use in form of military clothing, hard surface coatings for civil structures etc.
- Mosquito repellant paint which gives mosquito protection for one season at low costs. Efficacy has been tested with UN protocols. Mosquito repellant clothing with very safe efficacious use of UN approved actives
- Heat Stable & long lasting Fragrances which are stable upto 200 C in textile, industrial laundry, Detergents & printing ink applications.

**5th National Awards for Technology Innovation in Petrochemicals & Downstream Plastics Processing Industry (2014-2015)**

**by Prof. (Dr.) S. K. Nayak**

Director General - CIPET &

Chairman - 5th National Awards Committee

India is significantly progressing in the industrial world with economic growth and is expected to be one of the largest by the turn of this decade. Virtually, in all keys sectors of economy Agriculture, Infrastructure, Healthcare, Textiles and Consumer durables, polymers occupy a very important role.

The future of the Petrochemicals industry will be based on long term commitment to investment in R&D and strive for continuous innovation in terms of raw material usage, energy efficiency, process/operation improvement, technology forecasting and adoption of emerging technologies, in particular on recycling technologies, and recovery of energy from plastics waste, etc.

In line with the National Policy on Petrochemicals, with the view to promote and encourage development of environmental friendly process/technologies, innovation in polymeric materials and products, cost to performance balance, import substitution etc, Department of Chemicals & Petrochemicals (DCPC), Govt. of India, has announced a scheme-National Award for Technology Innovation in Petrochemicals and Downstream Plastics Processing industry-2014-15, with the core philosophy of “Reward the innovation suitably with an Award”.

## 5th National Awards for Technology Innovation in Petrochemicals and Downstream Plastics Processing Industry (2014-15)

Central Institute of Plastics Engineering and Technology (CIPET), an extended arm of Dept. of Chemical & Petrochemicals, Govt. of India has been entrusted with the task of processing of the applications/nominations, scrutiny and evaluation of nominations through field experts tills the completion of organizing successfully the award function.

During 2010-11, 09 nominations were declared as winners and during 2011-12, 15 nominations were declared as winners and 10 nominations as runner up. During 2012-13, 11 nominations were declared as winners and 05 nominations as runner up & During 2013-14, 17 nominations were declared as winners and 06 nominations as runner up. The winners of National Awards were awarded with Shield, Citation & Cash award and runners-up were awarded with Shield & Citation.

**The categories classified as given below:**

1. **Innovation in Polymeric Materials:**

   New Polymers, Blends & Alloys, filled materials, fibers, Polymer, Composites and Nano composites, Smart Materials etc.,

2. **Innovation in Polymeric Products:**

   New / creative product design, Non conventional application / Replacement of conventional materials (eg. Metals, ceramics etc.), Modification of product design for performance improvements.

3. **Innovation of Polymer Processing Machinery & Equipments:**

   Development of new processing techniques, Modification of machinery for higher efficiency/productivity / Automation, Energy conservation, product quality improvement, Improvement in moulds, dies and auxiliary equipments4. Innovation in Polymer Waste Management & Recycling Technology:

   Newer technology in plastic waste utilization into products/energy recovery, Recycling Technology, Plastic waste collection, segregation techniques, Product design for improved recyclability

4. **Innovation in Polymer Waste Management & Recycling Technology and Green Polymeric Materials & Products:**

   Newer technology in plastic waste utilization into products/energy recovery, Recycling Technology, Plastic waste collection, segregation techniques, Product design for improved recyclability

5. **Polymers in Agriculture and Water Conservation:**

   Water transportation, mulching, canal lining, Drip irrigation, Sprinkler system, Low Tunnels, Poly house etc., Controlled release system for fertilizer, pesticides, micro nutrients, etc., Innovative packaging for agriculture, floriculture and horticultural produce, Controlled permeability films & packaging for improved shelf life Novel Usage of plastics for food security.

6. **Polymers in Public Health care:**

   Affordable / cost effective implants, implements and devises, New innovative products for medical application, Polymer based new drugs delivery system, Polymer body implants, Drinking water storage& transportation, Polymer membrane for water purification /Desalination, Devices for waste water, drainage, sewage treatment system

7. **Research in the field of Polymer Science & Technology**

   Individual / Team of researchers in R & D Institutions & laboratories, original research work in polymeric materials processing etc. leading to proto type development & future industrial applications.

8. **Innovation not Covered under Seven Categories:**

**IMPLEMENTATION FRAMEWORK & OPERATIONAL MODALITIES :**

290 numbers of application/nominations received for awards were scrutinized and valuated by the nominated field experts headed by the Director General, CIPET & Chairman of 5th National Awards with the representatives from administrative Ministry / Government institution / Research laboratories / Academics Institution, National Level Industry Associations associated with petrochemical products and other representatives from Government of India. The recommendation of the Expert Committee was deliberated at the Prize Award Committee headed by the Joint Secretary of the Department of Chemicals & Petrochemicals. 16 nominations were finally selected and rewarded as WINNER, 14 nominations were rewarded as RUNNER-UP.

The fifth National Award Function - to encourage and to promote Technology Innovation in Petrochemicals and Downstream Plastics Processing Industry (2014-15) is being organized on February 21, 2015 at The Lalit Ashok, Bengaluru.

सेन्ट्रल इंस्टिट्यूट ऑफ प्लास्टिक्स इंजीनियरिंग एण्ड टेक्नोलॉजी (सिपेट)
**CENTRAL INSTITUTE OF PLASTICS ENGINEERING & TECHNOLOGY (CIPET)**
(Department of Chemicals & Petrochemicals, Ministry of Chemicals & Fertilizers, Govt. of India)
Head Office: Guindy, Chennai - 600 032, Tel: 044-22254780 Fax: 044-22254787 Email: nationalawardciept@gmail.com

## CENTRAL INSTITUTE OF PLASTICS ENGINEERING & TECHNOLOGY (CIPET)

(Department of Chemicals & Petrochemicals, Ministry of Chemicals & Fertilizers, Government of India) Head Office: Guindy, Chennai 600 032 Tel: 044-22254780 Fax: 044-22254787 Email: nationalawardcipet@gmail.com

Central Institute of Plastics Engineering & Technology (CIPET) is a premier National Institution devoted to Academic, Technology Support & Research (ATR) for the Plastics & allied industries in the India. Today CIPET operates a Hubs & Spoke= model with 23 locations spread across the length & breadth of the country, which includes 5-High Learning Centers, 11-Other Learning Centers, 2-R&D wings, 4-Specialized Centres, 2- Vocational Training Centres. All the CIPET centres have uniform infrastructural facilities in the areas of Design, CAD/CAM/CAE, Tooling, Plastics 'Processing, Testing & Quality Control to cater to the needs of plastics and allied industries in the country.

CIPET offers blend of various specialized Academic Programmes in the field of Plastics Engineering & Technology (Doctoral, Post Graduate, Undergraduate, Post Diploma or Diploma) in order to provide qualified human recourses to plastics & allied industries. The Technology Support service (TSS) to the industries and ingenious Research are the important product portfolios of CIPET.

CIPET renders Technology Support Services in Design, Tooling, Plastics processing, and Testing & Quality Assurance in India and abroad. CIPET's expertise as a third party inspection agency for plastics products as recognized by various Central & State Govt. organization for pre-dispatch/ delivery inspection of plastics & allied products.

CIPET has a R&D vision to be recognized as global R&D hub, in the area of Polymer Composites, Nanocomposite, Biopolymers, Functional Plastics, Carbon Nanotubes, Polymer Membranes, Conducting Polymers, Fuel Cells, E-Waste recycling etc., & Innovative product concept development & commercialization by aid of CAD/CAM/CAE expertise. Accordingly, CIPET has established two exclusive R&D centres viz. Advanced Research School for Technology & Product Simulation (ARSTPS) at Chennai and Laboratory for Advanced Research in Polymeric Materials (LARPM) at Bhubaneswar.

CIPET has signed various memorandum of Understanding (MoUs) for joint collaboration in faculty & staff exchange, student exchange, cooperative research exchange of academic materials etc., with leading international universities/ organizations at USA, Canada, Australia, Germany, France, Korea, Poland Mexico, China & Brazil.

With strong Alumni base of about 45,000 professionals, CIPET has emerged as an apex plastics technology institution, not only in India but a unique institution of its kid in Asia.

# 6th NATIONAL AWARDS FOR TECHONLOGY INNOVATION

## In Petrochemicals & Downstream Plastics Processing Industry

Government of India
Ministry of Chemicals & Fertilizers
Department of Chemicals & Petrochemicals

## INVITES

**Nomination from Individual / Team,**
**Small / Medium / Large scale Industry, Academic / R&D Institution for**

***Organised by:***

**CENTRAL INSTITUTE OF PLASTICS ENGINEERING & TECHNOLOGY (CIPET)**
(Department of Chemicals & Petrochemicals, Ministry of Chemicals & Fertilizers, Government of India)

For details visit : www.cipet.gov.in, www.pds.gov.in & www.chemicals.nic.in



5th NATIONAL AWARDS
TECHNOLOGY INNOVATION in Petrochemicals & Downstream Plastics Processing Industry 2014-15

*Organized by:*

सेन्ट्रल इंस्टिट्यूट ऑफ प्लास्टिक्स इंजीनियरिंग एण्ड टेक्नोलॉजी (सिपेट)

CENTRAL INSTITUTE OF PLASTICS ENGINEERING & TECHNOLOGY (CIPET)

(Department of Chemicals & Petrochemicals, Ministry of Chemicals & Fertilizers, Govt. of India)

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