



संकल्प

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CSIR-IIP-EIL WAX DE-OILING TECHNOLOGY FOR PRODUCTION OF PARAFFIN AND MICROCRYSTALLINE WAXES AT NUMALIGARH REFINERY, BPCL, ASSAM, FEBRUARY 5, 2016

The highlight of this quarter is the dedication of the NRL's Wax Plant to the nation on February 5, 2016 by Hon'ble Prime Minister of India Mr Narendra Modi at a public function held in Dibrugarh, Assam.

Also present on the occasion were Hon'ble Governor of Assam, Shri Padmanabha Balakrishna Acharya; Hon'ble Chief Minister of Assam, Shri Tarun Gogoi; Hon'ble Union Minister, Chemicals and Fertilizers, Shri Ananth Kumar; Hon'ble Union Minister of State (Independent Charge), Petroleum and Natural Gas, Shri Dharmendra Pradhan; Hon'ble Union Minister of State (I/C), Youth Affairs & Sports, Shri Sarbananda Sonowal; Hon'ble Union Minister of State (I/C), Ministry of Development of North Eastern Region, Dr Jitendra Singh; Hon'ble Union Minister of State, Chemicals and Fertilizers, Shri Hansraj Gangaram Ahir; Hon'ble Member of Parliament, Shri Rameswar Teli and Hon'ble Member of Legislative Assembly, Assam, Shri Prithvi Majhi.

The 50,000 metric tonnes per annum (MTPA) wax-plant built at a cost of Rs. 690 crores is the country's largest wax-producing unit using an indigenous technology jointly developed by the CSIR-Indian Institute of Petroleum, Dehradun, the Engineers India Limited and the Numaligarh Refinery Limited.

Leveraging on the inherent properties of wax-rich crude oil from the oil fields of Assam, the plant is designed to produce superior quality paraffin and semi-micro-crystalline wax and is a worthy manifestation of the 'Make in India' campaign of the Govt. of India. At present, a major part of the country's annual demand for paraffin wax along with the entire demand for micro-crystalline wax is being met through imports. NRL's wax plant will minimize the supply deficit in the domestic market substantially, thus reducing imports. NRL is also exploring opportunities to export wax to the neighbouring countries aligning with the 'Act East Policy' of the Govt. of India.

The wax plant will also open up opportunities for ancillary industries to thrive while creating avenues for a large-scale employment. The



Hon'ble Prime Minister of India Mr Narendra Modi inaugurating the Numaligarh Refinery Wax Plant

A word from the Director...

It was indeed a historic moment when the Hon'ble Prime Minister and the President, of CSIR, Shri Narendra Modi Ji, dedicated the Numaligarh Wax Plant to the nation. Perhaps one of the highest investments in an indigenous technology, this plant is an example of how a home-grown technology can help and support the industry to make more profit as well as to strengthen and grow the local industries.



For the first time, we held an open-house Research Council Meeting in our auditorium attended by everybody in the Institute. The meeting was very successful with very helpful comments from our Hon'ble RC members. Our relationship with Australia was further consolidated by holding the Australia-India joint symposium on "Nano-Porous Materials for Clean Energy Applications", inaugurated by the First Secretary in the Australian High Commission.

Our scientific curiosity continued unabated with more than 25 publications and I am happy to inform you that during this quarter we have had five patents granted and four patents filed. We endeavour to improve this record further.

It is indeed my privilege to take over as the Director of this prestigious Institute. I am deeply impressed by the motivation of the scientists as well as the track-record of this Institute in developing and commercializing state-of-the-art technologies. Of course, this does require the confidence of our stakeholders and the dedication of our staff and scientists. I look forward to taking the Institute to greater heights.

• Dr R A Vishwakarma

utility of paraffin wax lies in making candles, tarpaulin sheets, food-grade wrappers and also in PVC pipe-manufacturing industries while micro-crystalline wax finds widespread applications in the manufacture of tyres, rubber products, paints and polishes, pharmaceuticals and cosmetics.

OIL & GAS CONSERVATION FORTNIGHT (OGCF), JANUARY 15-31, 2016

Oil and Gas Conservation Fortnight (OGCF) is a joint yearly activity organized in the second fortnight of every January by the oil industry, i.e., the IOCL, the HPCL, the BPCL, along with the Petroleum Conservation Research Association (PCRA) and the CSIR-Indian

Institute of Petroleum, Dehradun, with dedication and enthusiasm. The aim is to spread, among all, the message of protecting petroleum product the valuable asset.



OGCF inaugural : dignitaries on the dais

The Fortnight was formally inaugurated on 15th January, 2016 at the Institute by Mr Dinesh Agrawal, Hon'ble Minister of Sports, Forests and Wildlife, Law & Justice, Govt. of Uttarakhand, in the presence of Dr M O Garg, the then Director, CSIR-IIP, Mr S K Sinha, State-Level Co-ordinator, Oil Industry, Mr C S Negi, Manager, HPCL, Dehradun and Dr D C Pandey, Head, Technical Directorate, CSIR-IIP & Chairman, Celebrations Committee, CSIR-IIP. The programme was initiated with the lighting of the inaugural lamp by the Chief Guest and the other dignitaries.



Mr Dinesh Agrawal

Mr Agrawal expressed his concern over the excessive use of this source of energy, that is, oil, and said that its extraction is a cause of worry for the mankind. He referred to the economic depression of recent times the world over and said that it is the inborn nature of the Indians to save which inured the country to the impact of this slump. He was of the opinion that the Fortnight would have achieved its purpose if the common masses could be motivated. It should be our foremost priority to devise ways of conserving energy. For this, we need to inculcate the habit of conforming to the norms set with this goal in mind. Today, most of India's energy needs are met with coal, crude oil, natural gas, hydro- and nuclear energy. He also stressed upon the need to convert to cycling as an environment-friendly and cheap alternative to the other modes of travelling, whenever and wherever possible, and said that besides the aforementioned qualities, it will also save oil and result in health benefits for the individuals. He also underlined the need to plant more trees to save the environment and to conserve natural resources.



Dr M O Garg

Dr M O Garg said that in today's context, the rôle of energy and environment has gained an unprecedented significance and the disbalance in environment is ever on the increase with the enhancement in the quantity of the 'Green House Gases'. It is the need of the hour not only to better the efficiency of energy utilization, but also to bring the use of energy to the minimum by creating an Energy Efficiency Market.



Mr S K Sinha

Mr S K Sinha, State-Level Co-ordinator, Oil Industry, gave a brief about the activities being taken up during the Fortnight. These included a very wide-scale communication project to drive home the message of conservation of energy/petroleum all over the State of Uttarakhand amongst the common masses, he said.

Mr C S Negi, Manager, MES & MIS, HPCL, Dehradun, proposed a vote of thanks.



Students, guests and officials get together for the 'Save Oil' message

The programme concluded with the formation of a human chain by the students of the Kendriya Vidyalaya, IIP, the Vivekananda School, Jogiwalla, the staff of the Institute besides the distinguished guests. The programme was convened by Dr D C Chamola, Senior Hindi Officer, CSIR-IIP.

AUSTRALIA-INDIA JOINT SYMPOSIUM ON NANO-POROUS MATERIALS FOR CLEAN ENERGY APPLICATIONS, MARCH 8, 2016

A one-day symposium on the theme 'Nano-porous Materials for Clean Energy Applications' sponsored by the Australian Government through the Australia-India Council of the Department of Foreign Affairs and Trade was jointly organized by the CSIRO Manufacturing, Victoria, Australia and the CSIR-Indian Institute of Petroleum, Dehradun on 8th March, 2016. The symposium was in the form of invited lectures from eminent scientists and engineers-both from Australia and India in the field of advanced materials synthesis and applications for gas separation, storage, catalysis, membrane applications, solar and molecular modelling.

CSIR-IIP has a very fruitful ongoing collaboration with many Australian Universities and Institutes for joint development of catalysis and separation-based technologies in several areas including utilization of stranded natural gas, bio-gas upgrading etc.

CSIR-IIP and CSIRO Manufacturing, Australia both are committed to the development of energy-efficient technologies related to clean fuel production, energy storage, climate change mitigation etc. The symposium aimed to develop a platform for detailed discussion among scientists and engineers from academia and industry of both the countries to share scientific ideas and breakthroughs in the field of nano-porous materials for clean energy applications. The theme



Opening moments of the symposium

of the symposium was well in alignment with one of the priority areas proposed in the Australia-India Council Strategic Plan 2015-19.

Nano-porous materials are at the heart of many industrial processes related to catalysis, separation, purification and energy storage. Intervention of high-performing functional porous materials in clean energy applications will become more and more important in coming years for bringing sustainability and low carbon footprint in our developmental agenda. This also gains significance in view of the recent pledge undertaken by the global community at the COP21 summit in Paris to limit the increase in the global average temperature to well below 2C above pre-industrial levels. Efficient production and use of energy will be crucial in meeting this goal.



Ms Hilary McGeach, Chief Guest, addressing the scientists

The Chief Guest of the Inaugural function was Ms. Hilary McGeach, First Secretary (Economic), Australian High Commission, New Delhi. In her address she stressed upon the importance of academic and industry interaction in tackling scientific and technical challenges of the future. She also introduced the functioning of the Australia-India Council as an interface for promoting such interactions.

About 82 delegates from various industrial organizations i.e., CSIRO-Australia, IGL, Reliance Technology Group-Vadodara, Technip, CSIR-CSMCRI, Bhavnagar, CSIR-CECRI, Karaikudi, BPCL, ONGC Energy Centre, GAIL and academic organizations, i.e., Graphic Era University, Dehradun, UPES-Dehradun, IIT-Roorkee, Rajiv Gandhi Institute

of Petroleum Technology, Rai Bareilly, participated in the symposium.



Dr M O Garg

Dr M O Garg, Scientist-H, CSIR-IIP and Dr Anshu Nanoti, Senior Principal Scientist, CSIR-IIP were the coordinators of the symposium. The symposium provided a richly interactive forum for scientists and engineers to exchange view-points on the rôle of advanced porous materials in clean energy applications. This helped enhance awareness towards the R&D efforts being undertaken in India and abroad among the general public.



Dr Anshu Nanoti

The symposium was divided into four thematic sessions, namely; 1) Design of Porous Materials; 2) Nano-porous Materials in Catalysis and Adsorptive Separation; 3) Porous Materials in action and; 4) Emerging Energy Materials in Membrane & Solar Applications.

The symposium was in the form of invited lectures from eminent scientists and engineers from Australia and India which

included Prof Matthew Hill, CSIRO Manufacturing, Victoria, Australia; Dr James McGregor, CSIRO Energy, Australia; Dr Ravichandar Babarao, CSIRO Manufacturing, Australia; Prof. Sourav Pal, IIT-Bombay, Mumbai; Dr Raksh Vir Jasra, Reliance Technology Group, Vadodara; Prof Sasidhar Gumma, IIT-Guwahati; Dr Nettem V Choudary, HPCL Corporate R&D, Bengaluru; Dr Anshu Nanoti, CSIR-IIP, Dehradun; Dr Ulhas Kharul, CSIR-NCL Pune and Dr Sundergopal Sridhar, CSIR-IICT, Hyderabad.



Photograph of Participants & organizers of the symposium

42nd RESEARCH COUNCIL (RC) MEETING – OPEN HOUSE

The 42nd Research Council (RC) Meeting of the Institute was held on January 22, 2016 in Dr Lovraj Kumar Auditorium. The Chairman of RC, Prof. Devang V Khakhar, IIT-Bombay and Members viz., Prof. I M Mishra, IIM- Dhanbad, Mr A S Basu, Head, Refinery, HMEI-Bathinda; Mr Nilkanth S Avhad, ED, PCRA, Delhi; Dr M O Garg, the then Director, CSIR-IIP; Mr A K Jain, Secretary, RC and All HoD's attended besides all the scientists, technical officers, technical staff and administrative personnel of the Institute.

In this open RC organized at the Institute in Dr Lovraj Kumar Auditorium, Dr M O Garg, the then Director, CSIR-IIP welcomed the Hon'ble Chairman & members of the RC and felicitated them. Mr. A. K. Jain, Member-Secretary, RC, presented a brief description of the RC agenda.

In his opening remarks, the Chairman, RC, expressed that the CSIR-IIP is a unique laboratory and the research activities of the Institute should be focussed on the petroleum industry and also on alternative energy-related technologies for future research. He appreciated the Institute's achievements, its continuous efforts towards development and commercialization of the technologies and pursuit of applied research. He also suggested carrying out high-quality basic research essentially required for developing indigenous world-class technologies in the hydrocarbon sector.



The Open House Meeting of the Research Council, CSIR-IIP

Dr M O Garg, the then Director, CSIR-IIP, presented the Director's Report covering the details of the research work being done in the Institute. He informed the RC about the highlights and achievements made by the Institute during the tenure of the present RC, viz., development and commercialization of technologies, EBR generated, projects completed, major projects undertaken in various divisions, creation of new facilities in the Institute, etc.

The Road map for future research till 2035 was also presented at the Meet

The other members laid emphasis on considering environmental and emission standards for future energy needs and suggested focussing on the conversion of bio-mass to gas fuels as solid bio-mass combustion is accompanied by the problem of smoke.

During the Meet, five technical presentations were made by the scientists of the Institute, viz., Dr Anshu Nanoti, Dr Thallada Bhaskar, Mr Devendra Singh, Mr G D Thakre and Mr Prasenjit Ghosh in their respective areas.

Successful Commercialization of Wax Deoiling Technology at the Numaligarh Refinery Limited (NRL)

M O Garg, S M Nanoti, Manoj Srivastava, Manoj Thapliyal & Sunil Kumar

CSIR-Indian Institute of Petroleum (CSIR-IIP) is a centre of excellence for development of cutting-edge technologies like 'Solvent Extraction' operating successfully in most of the Indian petroleum refineries. In 1980, the Institute started work on de-waxing and de-oiling processes for production of petroleum waxes. Waxes are used for a wide variety of applications. Paraffin wax (PW) is used for making candles, polishes, medicines, food packaging, paints, tyres, leather, etc., while micro-crystalline wax (MCW) is mainly used in the cosmetic industry. After carrying out a lot of research, the Institute successfully developed de-waxing and de-oiling technologies for making paraffin wax (PW) and micro-crystalline wax (MCW).

In India, there is a great demand of paraffin wax {230 thousand metric tonnes per annum (TMTPA)} and micro-crystalline wax (12.6 TMTPA). The current wax production capacity of 64 TMTPA of paraffin wax and 0.9 TMTPA of micro-crystalline wax in the country is enough only to meet one-fourth of country's wax requirement. The deficit in wax demand is met through import, but the quality of the imported wax is too inferior, with the result that the products made from these waxes are also of inferior quality.

The stage for the commercialization of the Institute's Wax Deoiling Technology was set during a meeting held between the Institute and the Numaligarh Refinery Limited (NRL) in the year 2000 to review the refinery configuration and maximize the refinery profit margins. At that time, the Numaligarh Refinery Limited was processing two waxy streams, namely, medium-vacuum gas oil (MVGO) and heavy-vacuum gas oil (HVGO) in its hydrocracker unit (HCU). During that meeting, the Institute suggested to the NRL that it is more advantageous to separate waxes (paraffinic hydrocarbons) from MVGO and HVGO streams and produce high-value petroleum waxes which are in great demand, rather than continuing with the current practice of processing MVGO and HVGO in its hydrocracker unit as these two waxy streams - which already contain saturated hydrocarbons - are cracked and saturated again by hydrogenation in the HCU. Adoption of the new technology will also increase refinery profitability

After this, the Institute had carried out a feasibility study to examine the possibility of producing marketable waxes from various streams such as LVGO, MVGO, HVGO and their blends available at the NRL. After seeing a great potential of wax production from MVGO and HVGO, the NRL requested the Institute to carry out a study on the optimum process schemes and generate data required for preparation of techno-economic feasibility report (TEFR). This study concluded that MVGO has the potential for producing fully refined paraffin wax, while HVGO has the potential for producing high-melting paraffin wax

or semi-micro-crystalline wax. Thereafter, the Institute made presentations to the NRL, summarizing benefits of using the wax de-oiling plant in order to produce high-value waxes and to get a better economic advantage.

Considering the demand-supply gap of paraffin and micro-crystalline waxes (PW & MCW) in India, the potential for producing waxes from the Assam Crude and the lucrative prices of these waxes as compared to transportation fuels (2.0 to 2.5 times), the BPCL management decided to set up a wax plant at the Numaligarh Refinery. The Institute engaged the Engineers India Limited (EIL) to provide the required engineering support for the wax plant. The EIL prepared a techno-economic feasibility report (TEFR) and a detailed feasibility report (DFR) for setting up of a wax plant at the NRL. The DFR projected a payback period of 2.8 years for the wax plant. Based on this DFR, a note was put up to the BPCL Board for setting up of a wax plant and it was approved by them. Subsequent to this, the NRL floated quotations for the setting up of the wax plant. The CSIR-IIP and the EIL won the bid for setting up of the desired wax plant, even against stiff competition from the international process licensors in the wax production technology. The Institute fine-tuned the technology based on the NRL's requirements by incorporating several novel features and



A view of the Numaligarh Refinery's Wax Plant

technological advances. Finally, the NRL awarded the job for setting up of wax plant to the Institute and the EIL.

The NRL wax plant is designed to produce 50,000 MTPA of high-value food-grade paraffin wax and 4,500 MTPA of semi-micro-crystalline wax. The construction of the NRL wax plant began in January, 2011. The mechanical work was completed in October, 2014, while the commissioning of wax plant was completed in March, 2015. The NRL made an investment of the order of Rs. 690 crores on setting up of this plant. Finally, the

Numaligarh Refinery Limited (NRL) started commercial production of paraffin wax from February, 2016 onwards. This is the first wax plant set up by any petroleum refinery in the



Another view of the Plant

country based on an indigenously developed technology and with the largest investment in this field.

This wax de-oiling technology involves processing of low-value waxy distillates in a series of steps comprising of extractive fractional crystallization, filtration and solvent recovery and applies methyl-iso-butyl ketone (MIBK) as a selective solvent. The features of the solvent dewaxing-deoiling technology are: lower solvent-to-feed ratio with prudent filtrate recycle, optimum solvent dilution scheme combining delayed dilution, incremental dilution and cold dilution techniques for maximum gains, controlled crystallization for larger crystals with narrow crystal size distribution, two-stage filtration with balanced filter cycle, energy-efficient process with built-in operational flexibility, continuous process back-up etc. The salient feature of this technology which sets it apart from the other competitors is its low capital cost and low energy-intensive process because a furnace has been eliminated from the solvent recovery section through application of pinch analysis. This helped the NRL reduce carbon foot-print considerably.

After setting up the wax de-oiling plant at the Numaligarh



Filtration Section (Rotary Drum Filter)

Refinery, the gross refinery margins (GRM) of the refinery increased to the tune of USD 0.53/bbl which is equivalent to Rs 77 crores per year based on the current NRL refining capacity of 3 million tonnes in respect of the Assam crude. The production of wax at NRL has cut the wax import down by 50% and has saved the foreign exchange of the order of Rs 500 crores/annum. This commercialization is in line with the 'Make in India' initiative taken by the Government of India (GoI).

This plant was dedicated to the nation by the Hon'ble Prime Minister of India and President of the Council of Scientific and Industrial Research (CSIR), Mr Narendra Modi, at a function at Lepetkata, near Dibrugarh, on February 5, 2016.

The Prime Minister in his address mentioned that the technology for the NRL wax plant was developed by the scientists of the CSIR-Indian Institute of Petroleum (CSIR-IIP). The Prime Minister remarked that this project is important because it provides value-addition to the natural product (Assam Crude) as well as employment opportunities for the youth of Assam.

Licensing of the technology to the NRL and the confidence reposed by the NRL-BPCL Board in CSIR-IIP-EIL-NRL technology has opened up the market for providing know-how for any other new unit that may come up in the country. The CSIR-IIP-EIL-NRL Wax Technology has also opened up an opportunity for the export of this indigenous technology, as its commercial reference is available now.



View of Wax Slabbing Unit



Candles : One of the wax products

MoU's SIGNED

- Non-disclosure Agreement with M/s SKI Carbon Black India Pvt. Ltd., Mumbai, on the testing, analysis and evaluation of the carbon black feedstock produced and provided by M/s Birla Carbon.
- Non-disclosure Agreement with M/s Projects & Development India Limited, Noida, 'for cost estimation for 1TPD waste plastic-to-diesel pilot plant'.
- Non-disclosure Agreement with M/s Renault-Nissan Technology & Business Centre India Pvt. Ltd., Kancheepuram, for experimental studies 'for the ethanol reforming process for different catalysts'.
- MoU with the Bharat Petroleum Corporation Limited, Mumbai, on 'Mini-DME: a custom-designed solution to bring stranded gas to the energy market'.

RESEARCH ACTIVITIES

Sponsored Projects Taken Up

- Studies to establish the cause of colour instability of ATF products and identification of components responsible
- Feasibility study for processing HWD stream at the Digboi Refinery of the IOCL (AOD)
- Testing of oil samples
- Evaluation of FRHF samples
- FZG test on turbine oil sample as per ASTM D5182
- Gear teeth surfaces distress rating of transmission gear box and rear axle unit
- Preparation of DPR for setting up of pressure swing adsorption (PSA) CO₂ capture pilot plant in one of the coal-fired power plants
- Development of catalytic process for production of isoprene from pure isopentane containing refinery C₅ streams
- C Ex Lab test of samples of LEF Bottom-Reg
- Detailed evaluation studies on the Rajahmundry crude oil sample
- Compatibility studies for lubricants and greases
- Testing of HFB-68 type FRHF, branded as 'Aquacent Light'
- COP testing

Sponsored Projects Completed

- Desulphurization of fuel oil using solvent extraction
- Technology development for adsorbed natural gas
- Feasibility study for making zero pen bitumen using bitumen feed via air blowing
- Study for carrying out the slurry viscosity of PWD stream with MIBK solvent at four different operating temperatures for the Digboi refinery of the IOCL (AOD)
- Development of catalyst for production of syngas from CO₂ and methane
- Indo-US joint center on elastohydrodynamic lubrication studies
- Evaluation of hydraulic oil IML hydrol 68 for FZG test
- Determination of shock load and channeling characteristics of gear oil and quenching speed characteristics of quenching oil
- Evaluation / testing of HFDU & HFC type of fire-resistant hydraulic fluids (FRHF's)

- Carrying out crude assay analysis of Karanannagar crude oil sample
- Studies on a chemical sample
- Studies on bio-diesel

RESEARCH OUTPUT

Papers Published

- An investigation into the lubricity characteristics of polyethylene glycol blends with cellulose palmitates, *Raj K Singh, Aruna Kukrety, Raghuvir Singh, Sandeep Saran and O P Sharma*, Waste and Biomass Valorization, 6, (6), 1067-1076, December 2015
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- Ethanol production from rice straw using thermotolerant *Kluyveromyces* sp. IPE453, *Rakesh Kumar Jain, Debashish Ghosh, Deepti Agrawal, Sunil Kumar Suman, Diwakar Pandey, Vasantha Thakur Vadde, Ashwini Kumar Dixit, D K Adhikari and Diptarka Dasgupta*, Biomass Conversion and Biorefinery, 5(4), 331-337, December 2015
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- Visible light-assisted photocatalytic [3+2] azide-alkyne "click" reaction for synthesis of 1,4- substituted 1, 2, 3-triazoles using a novel bi-metallic Ru-Mn complex, *Suman L Jain, Pawan Kumar, Chetan Joshi, Ambrish Kumar Srivastava, Piyush Gupta and Rabah Boukherroub*, *ACS Sustainable Chem. Eng.*, 4(1), 69-75, January 2016
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 - Role of reaction temperature on pyrolysis of cotton residue, *Bhavya B Krishna, Bijoy Biswas, Jitendra Kumar, Rawel Singh and Thallada Bhaskar*, Waste and Biomass Valorization, 7(1), 71-78, February 2016
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 - Amino acid ionic liquid-bound copper Schiff base-catalyzed highly efficient three-component A3-coupling reaction, *Manish Varyani, Praveen K Khatri and Suman L Jain*, Catalysis Communications, 77(5), 113-117, March 2016
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 - Catalyst and process for conversion of bio-ethanol into gasoline, *N Viwanadham and Sandeep K Saxena*, USA, Patent No. 9,267,081, dt. 23.02.2016
- Patent(s) Sealed in India**
- A process for preparation of liquid lubricants from non-edible vegetable oils, *V K Chhibber, A K Gupta, O N Anand and Jaideep Mehta*, Patent No. 271024, dt. 29.01.2016
 - A process for removal of sulfones from oxidized hydrocarbon fuel, *Anshu Nanoti, Soumen Dasgupta, A N Goswami, B R Nautiyal, TV Rao, Bir Sain, YK Sharma, SM Nanoti, MO Garg and Pushpa Gupta*, Patent No. 271035, dt. 29.01.2016
 - A process for preparation of p-toluic acid by liquid phase oxidation of p-xylene in water, *M P Saxena, A K Gupta, S K Sharma, DP Bangwal and Krishan Kumar*, Patent No. 271267, dt. 12.02.2016
- Patent(s) Filed Abroad**
- Integrated process for simultaneous removal and value-addition to the sulphur and aromatics compounds of gas oil, *Sunil Kumar, S M Nanoti, M O Garg, B R Nautiyal, Prasenjit Ghosh, Pooja Yadav and Nisha*, USA, Application No. 15/077,707, dt. 23.03.2016
 - Nano Ni-Zr oxide catalyst for activation of methane by Tri-reforming and a process for preparation thereof, *Rajaram Bal, Rajib Kumar Singha, Ankur Bordoloi, Chandrashekar Pendem and L N Sivakumar Konathala*, USA, Application No. 15/085,697, dt. 30.03.2016
 - Preparation method of slurry phase organic-inorganic fused hybrid catalyst used in residue hydroprocessing, *Ravindra Prajapati, Kritika Kohli, S K Maity and M O Garg*, USA, Application No. 15/085,661, dt. 30.03.2016
- Patent(s) Filed in India**
- Adsorbent derived from bamboo for high pressure methane storage application, *Anshu Nanoti, Aamir Hanif, M O Garg, Soumen Dasgupta, Swapnil Divekar, Aarti, Raj Kumar Kashyap (GAIL), Thenmani, Nandkumar (GAIL) and Anil Sood (CSIR-IHBT)*, Application No. 201611003824, dt. 03.02.2016 (Jointly with GAIL and IHBT)

TRAINING PROGRAMMES ORGANIZED

Programmes on Petroleum Refining Technology

- For the engineers of the Indian Oil Corporation Limited (IOCL), New Delhi, January 11 – February 26, 2016



Programme on Petroleum Refining Technology, January 11-February 26, 2016

- For the officers of the Bharat Petroleum Corporation Ltd., (BPCL), Mumbai, February 22 - March 11, 2016

Other Programmes

- Programme on 'Operation and maintenance of CFR engines' for different refineries, January 11-22, 2016
- Programme on 'Bitumen testing' for an Executive of M/s Arun Oil Labs Pvt. Ltd., January 25-28, 2016
- Workshop-cum-training programme on 'Alternative fuels for road and transportation' for the Officers of the Ministry of Road Transport & Highways (MRTH), New Delhi, February 15-19, 2016



Programme on alternative fuels, February 15-19, 2016

- Workshop-cum-training programme on *Advanced automotive technology and Indian road traffic patterns-challenges and opportunities* for the Officers of the Ministry of Road Transport & Highways (MRTH), New Delhi, March 14-18, 2016

EXCHANGE OF KNOWLEDGE

Papers Presented in Conferences/Seminars/Symposia

2nd International Symposium on Ionic Liquids (ISOIL), ICIT, Mumbai, January 21-22, 2016

- Task-specific halogen-free ionic liquids: designed chemistry to lubricant applications, O P Khatri
- Self-assembled ultrathin coating of imidazolium hexafluorophosphate ionic liquid on silicon surface: structural characterization to tribo-evaluation, Rashi Gusain, Sho Kokufu, Toru Utsunomiya, Takashi Ichii, Hiroyuki Sugimura and O P Khatri
- Anti-microbial activities of benzotriazolium cation-based ionic liquids, Paramjeet S Bakshi, Rashi Gusain, Manisha Dhawaria, Sunil K Suman and O P Khatri

NCRTDME-2016, DIT, Dehradun, January 22-23, 2016

- Tribo-performance investigation of thin-film polymer coating on steel substrates in rolling contacts, Deepika Chamoli, G D Thakre, P K Arya and A K Jain
- Experimental investigation of CdS nano-particles as additives for

mineral oils for Industrial applications, Ajay Kumar, G D Thakre, P K Arya and A K Jain

- Experimental investigation on tribological properties of functionalized Cu nano-particles as bio-lubricant additive, Pooja Garg, Ajay Kumar, G D Thakre, P K Arya and A K Jain

17th Asia Pacific Corrosion Control Conference, IIT-Mumbai, January 27-30, 2016

- Corrosion studies of bio-diesel blends, R C Saxena and S S Ray
- 10th Uttarakhand State Science and Technology Congress, UCOST, Dehradun, February 10-12, 2016

- A comparative assessment of the tribological performance of mineral and bio-oil-based lubricants, Pooja Garg, Ajay Kumar, G D Thakre, P K Arya and A K Jain

- A comparative assessment of the tribological performance of Hex-BN and MoS₂ micro-fluids, Ajay Kumar, G D Thakre, P K Arya and A K Jain

- Importance of rheological studies of bituminous binder for flexible pavement, Kamal Kumar, Anand Singh, Manoj Srivastava and SK Maity

- Nickel decorated graphene oxide/polyaniline hybrid: A robust and highly efficient heterogeneous catalyst for hydrogenation of terminal alkynes, Vineeta Panwar, Arvind Kumar, Raghuvir Singh, Piyush Gupta, S S Ray and Suman L Jain

- Study of a novel triazine as a multi-functional lubricant additive for bio-lubricants, G M Bahuguna, Aruna Kurkrety, Raj Kumar Singh and S S Ray

Biofuel and Bioenergy (BICE-2016), MANIT, Bhopal, February 23-25, 2016

- Comparative life-cycle energy analysis (LCA) of bio-gas utilization using two different feedstocks, Krishan C Joshi, Pankaj K Arya, Satish Kumar, G D Thakre and A K Jain

International Conference on Materials Science and Technology (ICMTech), University of Delhi, March 1-4, 2016

- Oxidative coupling of methane of Na₂WO₄/MOx-SiO₂ (M=Mn and Co) catalysts: comparison of successive impregnation and solution combustion synthesis methods, Shailendra Tripathi, Manoj Kumar and Pendem Chandrashekar

International Conference on Advanced Materials for Energy, Environment and Health (ICAM-2016), IIT-Roorkee, March 4-7, 2016

- Trioctylalkylammonium bis(salicylato)borate ionic liquids as novel and environmentally friendly lubricants for reduction of friction, Paramjeet S Bakshi, Rashi Gusain and O P Khatri

- Octadecylamine-intercalated graphene oxide as a novel material for enhanced lubrication properties, Harshal P Mungse, Niranjana Kumar and O P Khatri

- Hierarchical microsphere of MoS₂ nano-sheets as high-performance lubricants for tribological applications, Sangita Kumari, Rashi Gusain, Niranjana Kumar and O P Khatri

- Synthesis of MoS₂ nano-sheets for efficient and fast adsorption of organic dyes from simulated waste water, Anushka Tina Massey, Rashi Gusain, Sangita Kumari and O P Khatri

- Halogen-free ionic liquids as environmentally friendly multi-functional additives for energy-efficient lubrication applications, Rashi Gusain and O P Khatri

National Conference on Emerging trends in Pharmaceutical and Chemical Sciences (ETPCS-2016), Sri Venkateswara University, Tirupati, March 28-29, 2016

- Novel Synthesis of methods of nano porous/nano materials for effective catalytic applications, *N Viswanadham*

Colloquia and Talks

- Mr Sakeer Hussain, Manager, IPR Solutions, Patracode Services Pvt. Ltd., '*Practical demonstration: use and benefits of the 'Orbit' patented database tool*', January 5, 2016
- Mr Harshal P Mungse, Research Scholar, CSIR-IIP, '*Development of graphene oxide-based materials for tribology applications*', February 29, 2016
- Mr Anand Mohit, Scientist, CSIR-IIP, '*Hydroprocessing route to renewable transportation fuels*', March 10, 2016
- Mr Subhash Kumar, Research Fellow, CSIR-IIP, '*Influence of molecular composition of petroleum feed-stocks and catalyst on mesophase development and their coke morphology*', March 16, 2016

Lectures/Key-note Addresses etc.

- Dr M O Garg, the then Director, delivered an invited lecture on '*Challenges & Opportunities—Energy & Petrochemicals*' at the Indian Institute of Technology, Hyderabad, February 3, 2016
- Dr M O Garg, Scientist-H, was invited as the Chief Guest to, and delivered a lecture entitled '*Agony and Excitement in Commercializing Research*' in, the '*Research Scholars' Symposium (RSS) 2016*' at IIT, Bombay, February 13, 2016

DISTINGUISHED VISITORS

- Dr D N Singh, GGM-HOI, Oil and Natural Gas Corporation Limited, Dehradun, January 7, 2016
- Mr G S Uppal, Director, Hero Oil Limited, England, January 13, 2016
- Mr K S Verma, Consultant, KLJ Resources Limited, New Delhi, January 13, 2016
- Prof. Devang. V. Khakhar, Director, IIT-Mumbai; Prof I M Mishra, IIM-Danbad; Mr A S Basu, Head, Refinery, HMEL-Bathinda and Mr Nilkanth S Avhad, ED, PCRA, Delhi, January 22, 2016
- Dr H Purushotham, Chairman and Managing Director, National Research Development Corporation (NRDC); Mr A Pradhan, Chief (Business Development), NRDC; Mr D C Joshi, Chief (Business Development), NRDC; Mr Subodh Chawla, Sr. Manager, NRDC and Mr N K Bhandari, Sr. Manager, NRDC, January 25, 2016
- Dr B Bhargava, D-G, ONGC Energy Centre, New Delhi; Dr D Parvatalu, Project Manager, ONGC Energy Centre, New Delhi; Mr S Banerjee, Project Manager, ONGC Energy Centre, New Delhi; Dr Nandini Das, Scientist, CSIR-CGCRI, Kolkata; Dr Vinod Shahi, Principal Scientist, CSIR-CSMCR, Bhavnagar; Prof. A N Bhaskarwar, IIT-Delhi; Prof. Anupam Shukla, IIT-Delhi and Prof. U Sreedevi, IIT-Delhi, January 27, 2016
- Dr Chandra Ratnasamy, Head, R&D, Clariant Corporation Catalyst, USA; Mr Hal Walls, Director, Clariant Corporation Catalyst, USA; Mr Alexander Sasha Gulieff, Technical Sales Engineer, USA and Mr Dinesh Kumar, Vice President R&D, Sud-Chemie India Pvt. Ltd. Vadodara
- Dr M Naseem, Director, Defence Institute of Bio-Energy Research, Haldwani, January 28, 2016

- Dr R N Maiti, DGM(R&D); Mr Vijaya Yalaga, Dy. Manager (R&D) and Mr Ranjoy Basu, Engineer (R&D), EIL, New Delhi, for discussion on PSA & slurry hydrocracking; February 9-10, 2016.
- Mr Santosh Dutta, Programme Manager, Robert Bosch Engineering and Business Solutions Limited, Bangalore, February 10, 2016.
- Mr Anitesh Pattanayak, Vice President-Business Development and Mr Tanmay Taraphdar, Chief Engineer-Process Technology, Technip India Limited, NOIDA, February 15, 2016.
- Mr David Lelliott, Deputy High Commissioner and Mr. Javid Malla, Infrastructure, Energy & Low-Carbon Growth Advisor, British Deputy High Commission, Chandigarh, February 16, 2016.
- Mr Rishabh Jain, Director, Ganesh Explosives, Dehradun, February 16, 2016.
- **MWijju iky] ofj" B fgluh vf/kdkjh ¼ I th¼ I h , I vkb vkj] ublfnyh] Qjoh 17&19] 2016**
- Mr Brijesh Kumar, Executive Director and Mr AS Pathak, Director, Centre for High Technology, NOIDA, February 18, 2016.
- Mr Vijay Kumar Suhjani, General Manager and Dr M N Saheesh Kumar, Head R&D Kluber Lubrication India Pvt. Ltd., Bangalore, February 24-25, 2016.
- Prof (Dr) Samuel Donkor, President, All Nations University, Ghana, February 26, 2016.
- Mr T Nandakumar, Sr. Manager, GAIL India Ltd., NOIDA, March 9-10, 2016
- Prof Michael Wensing and Mr Sabastian Rieb, Friedrich Alexander Universitat, Germany, March 14-16, 2016.
- Mr H K Abhisek, Director, Green Earth Bio Fuel Tech. Pvt. Ltd., Bangalore, March 14, 2016

INTERNATIONAL VISITS

- Visits to Australia for technical meetings and discussions under the AISRF Grand Challenge Project entitled '*Mini DME : A custom-design solution to bring stranded gas to the energy markets*' sponsored by DST, New Delhi:
 - ~ Dr M O Garg, Scientist-H, Dr S M Nanoti, Chief Scientist and Dr Rajaram Bal, Senior Scientist, February 29 to March 4, 2016
 - ~ Dr Ankur Bordoloi, Scientist, February 29 to March 11, 2016
- Dr Thallada Bhaskar, Principal Scientist, was invited to attend the '*Third 3R International Conference on Material Cycles and Waste Management (3RINCs)*' by the Institute of Strategy and Policy on Natural Resources and Environment (ISPONRE), Vietnam, March 9-11, 2016

PARTICIPATION IN CONFERENCES/SEMINARS/WORKSHOPS/ BRAINSTORMING SESSIONS/DISCUSSIONS

- Dr M O Garg, the then Director, discussion on '*Scientific Temper : A Pre-requisite for Knowledge Based Society*', Vigyan Bhavan, New Delhi, January 10, 2016
- Dr M O Garg, the then Director, discussion on '*Dehradun Declaration: Monitoring of the Outcome-driven Deliverables*', CSIR Science Centre, New Delhi, January 13, 2016
- Mr R C Saxena, Sr Technical Officer, '*17th Asia-Pacific Corrosion Control Conference*', organized by NACE International and IIT, Bombay, IIT-Bombay, January 27-30, 2016

- Dr M O Garg, the then Director, participated in the 'Global Bio-technology Summit' at the Vigyan Bhawan, New Delhi, February 6, 2016
- Dr M O Garg, the then Director, attended the '10th Uttarakhand State Science & Technology Congress (USSTC)' as the Special Guest at its inaugural function at the Vigyan Dham, Jhajra, Dehradun, February 10, 2016
- Mr G M Bahuguna, Sr Technical Officer, Mr Raghuvir Singh, and Mr Kamal Kumar Maurya, Technical Assistants, '10th Uttarakhand State Science and Technology Congress', organized by the UCOST, Uttarakhand, Dehradun, February 10-12, 2016
- Mr Diptarka Dasgupta, Scientist, 'National Seminar on Lignocellulose to Ethanol-Roadmap for India' organized by the Ministry of Petroleum & Natural Gas, New Delhi, February 11, 2016
- Dr Shailendra Tripathi, Senior Scientist, 'International Conference on Materials Science & Technology (ICMTECH 2016)', Delhi University, Delhi, March 3-4, 2016
- Dr M O Garg, Scientist-H, Dr S K Maity, Senior Scientist, Dr Manoj Srivastava, Senior Scientist, Mr Manoj Thapliyal, Sr Technical Officer and Mr Satya Niketan Yadav, Technical Officer, 'Lovraj Kumar Memorial Trust Workshop-2016', New Delhi, jointly organized by the IICHE (NRC), EIL, Petrotech Society and Petrofed, March 10 to 11, 2016

IMPORTANT MEETINGS ATTENDED

- Dr M O Garg, the then Director, chaired the meeting of the CSIR Committee for a review of the Purchase Rules/Manual at the CSIR Headquarters, New Delhi, January 8, 2016.
- Dr M O Garg, the then Director, attended the Meeting of the PCD:1 and its sub-committees at the Bureau of Indian Standards (BIS), New Delhi, January 11-12, 2016
- Dr M O Garg, Scientist-H, '51st meeting of the Standing Committee on Emission Legislation (SCOE)', Ministry of Road Transport and Highways, New Delhi, March 28, 2016

HRD/AWARENESS EVENTS

Programmes at the CSIR-HRDC, Ghaziabad

- Dr A K Sinha, Principal Scientist; Mr Devendra Singh, Senior Scientist; Dr Raj Kumar Singh, & Mr Swapnil Divekar, Scientists, '6th CSIR Leadership Development Programme', January 11-21, 2016
- Dr Raj Kumar Singh, Scientist, participated in the '6th CSIR Leadership Development Programme', March 13-17, 2016

EXPOSURE OF STUDENTS TO OUR SCIENTIFIC INTELLECT & INFRASTRUCTURE

Visits of students/different groups of students/cadets/trainers/trainees/faculty members from the following institutions/colleges/regions/states

- Cadets of the Rashtriya Indian Military College (RIMC), January 29, 2015
- Students of the Graphic Era University, Dehradun, February 16, 2015
- Trainee Teachers of Teacher SITY, Delhi, March 14, 2016

CAPABILITIES / ACTIVITIES OF THE INSTITUTE BROUGHT TO THE FORE

Showcasing-cum-Exhibition on the occasion of the '10th Uttarakhand State Science and Technology Congress-2016', Jhajra, Dehradun, February 10-12, 2016

The Institute participated in the Exhibition held on the occasion of

the '10th Uttarakhand State Science and Technology Congress-2016', organized by the Uttarakhand State Council for Science and Technology (UCOST).

The exhibition was inaugurated by Sh Surender Singh Negi Hon'ble Minister of S&T, Uttarakhand.

The Institute showcased its latest technologies, products and research work through posters/exhibits.

A number of delegates/visitors thronged the stall and interacted with our scientists.

STRENGTHENING OUR INFRASTRUCTURE

A major step forward was achieved for the long-felt need for a 'Business-cum-Training Centre' (BTC). The BTC will cater to the outreach needs of the Institute by way of entering into agreements with national and international organizations/business houses/academic institutes etc. and training the personnel from the



Dr MO Garg unveils the Foundation Plaque of the B.C.T Centre

oil industry and transport-related government departments etc. The foundation stone of the Centre was laid on January 4, 2016 by Dr M O Garg, the then Director.

HONOURS & AWARDS

- The first state-of-the-art grassroots Wax Deoiling Plant based on the Wax Deoiling Technology indigenously developed by the Institute in association with the Engineers India Ltd (EIL) and the Numaligarh Refinery Ltd (NRL), was dedicated to the nation by Shri Narendra Damodardas Modi, Hon'ble Prime Minister of India, February 5, 2016.
- The work entitled 'Halogen-free ionic liquids as environmentally friendly additives for energy-efficient lubricant applications' presented by Dr Rashi Gusain was considered for the Award of Honour at the 'International Conference on Advanced Materials' at IIT-Roorkee, February 4-7, 2016
- Mr Raghuvir Singh received the 'Young Scientist Award' for the best oral presentation under the category of Chemistry in the '10th Uttarakhand State Science & Technology Congress-2016', held in Vigyan Dham, Jhajra, Dehra Dun, February 10-12, 2016.

PhD/D Phil DEGREE AWARDS

- Mr M G Sibi was awarded Ph.D. degree on his thesis entitled 'Synthesis, Characterization and Application of Metal/Metal Oxide Catalysts for New-Generation Fuels'. The research work was carried out under the supervision of Dr A K Sinha under the Academy of Scientific & Innovative Research (AcSIR).
- Ms Rashi Gusain was awarded Ph.D. degree on her thesis entitled 'Halogen-Free Ionic Liquids: Synthesis, Characterization and their Potential for Lubrication Applications'. The research

!!! WELCOME !!!
!!! DR RAM A VISHWAKARMA !!!



CHANGE AT THE HELM

Dr Ram A Vishwakarma, Director, CSIR-Indian Institute of Integrative Medicine, Jammu took over the additional charge of the Director, CSIR-IIP on February 13, 2016. He addressed the whole Institute in Dr Lavraj Kumar Auditorium on February 18, 2016.

DR RAM VISHWAKARMA: A BRIEF PROFILE

Professional Experience

From a Research Fellow (CSIR) at the Central Drug Research Institute, Lucknow and then successively to the Defense R&D organization (Govt. of India), the Central Institute of Medicinal & Aromatic Plants Lucknow, the Cambridge University (Dept. of Chemistry) UK, the National Institute of Immunology, New Delhi, Piramal Life Sciences (Nicholas Piramal Research Centre), Mumbai, to the position of the Director, CSIR-Indian Institute of Integrative Medicine, Jammu (March 2009 onwards), Dr Vishwakarma has more than three decades behind him as an illustrious professional in medicinal chemistry before he was entrusted the position of the Director (Additional Charge), CSIR-Indian Institute of Petroleum, Dehradun by the CSIR on February 13, 2016.

Education

An M.Sc. (Organic Chemistry) from the Bundelkhand University, India (1978-1980), he did his Ph.D. (Medicinal Chemistry) from the Central Drug Research Institute Lucknow CSIR, and continued his Post-doctoral studies at the Cambridge University, England with Sir Alan Battersby, FRS, on bio-synthesis of Vitamin B₁₂ and related corrins and porphyrins during 1991-1993.

Research Expertise and Interests

Dr Vishwakarma has about 28 years of research experience in drug discovery, medicinal chemistry, chemistry of natural products, organic synthesis, chemical biology and glycobiology etc.

Recognitions and Professional Associations

Dr Vishwakarma's calibre has also earned him various awards and prestigious positions, fellowships and memberships.

He has also supervised a number of Ph.D. students both in chemistry and biology.

Visiting Assignments

Dr Vishwakarma has been a Visiting Scientist at the Cambridge University, UK, the Institute Armand-Frappier, University of Quebec, Canada and the Virginia Tech University, Blacksburg, USA, in 1991, 1996 & 2000-2001, respectively.

Research Publications and Patents

Dr Vishwakarma has more than two hundred research publications and about seventy granted patents to his credit. He has filed several patents besides these.

We are proud to have Dr Vishwarma as the latest link in the illustrious chain of the CSIR-IIP Directors!

ECF during the Financial Year 2015-2016
(Rs. in lakhs)

Category	Govt.	Private Industries	PSE's/ Refineries	Foreign Companies	Total
Sponsored R&D	28.394	123.69638	466.65067	21.41187	640.15292
Grant-in-Aid R&D	352.38731	...	...	...	352.38731
Collaborative/ Co-operative R&D	...	...	7.62812	...	7.62812
R&D Consultancy	190.69978	...	...	...	190.69978
Training Services	23.10016	25.84406	153.121	...	202.06522
Technical Services & Misc.	7.69631	9.48405	1.22683	...	18.40719
Premia/Royalty	...	3.23894	3.23894
Total	602.27756	162.26343	628.62662	21.41187	1414.57948

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