वार्षिक प्रतिवेदन

ANNUAL REPORT 2014-15

सीएसआइआर–भारतीय पेट्रोलियम संस्थान, देहरादून

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निदेशक की कलम से.....

मुझे अपने संस्थान की उपलब्धियों व योगदानों को रेखांकित करते वर्ष 2014-15 के सीएसआइआर-भापेसं के वार्षिक प्रतिवेदन को प्रस्तुत करते हुए अत्यंत हर्ष हो रहा है। मुझे प्रसन्नता है कि वर्ष 2014-15 के दौरान संस्थान ने अतुलनीय रूप से सर्वांगीण प्रगति की है, जिसमें उच्च विज्ञान, प्रौद्योगिकी-उन्मुख अनुसंधान, प्रौद्योगिकी विकास और वाणिज्यीकरण, मानव संसाधन विकास, सामाजिक भागीदारी, और उद्योग-क्षेत्र के साथ हमारे सहयोग को पुष्ट करना व उन्हें सहयोग देना-ये सभी सम्मिलित हैं।

मुझे आपको यह सूचित करते हुए प्रसन्नता है कि अपने सतत व अथक प्रयासों के फलस्वरूप हमने हल्दिया परिष्करणी (आइ ओ सी एल) की श्यानताभंजक इकाई के सिक्तक ड्रम में प्रगत इंटर्नलों के संस्थापन हेतु सीएसआइआर-भापेसं की प्रौद्योगिकी के कार्यान्वयन का आदेश प्राप्त कर लिया है; एच पी सी एल, विशाखापट्टणम एवं आइ ओ सी एल, मथुरा के बाद यह तीसरा संस्थापन है। हमने भारत व विदेशों में भी 'थॉक्सकैट-ई एस' उत्प्रेरक (एल पी जी मधुरण हेतु) के वाणिज्यीकरण के लिए अपने प्रयास जारी रखे हैं; ओमान-स्थित सोहार परिष्करणी में भी इसके लिए उत्साहजनक संभावनाएं हैं। हम, अपशिष्ट प्लास्टिक से डीजल, जैव-जेट ईंधन आदि हेतु अपनी प्रौद्योगिकियों के वाणिज्यीकरण हेतु उत्साहपूर्ण प्रयत्न जारी रखे हुए हैं। बौद्धिक-संपदा अधिकारों पर अपना ध्यान केंद्रित करते हुए हमें 8 विदेशी व 5 भारतीय एकस्व प्रदान किए गए हैं, जबकि हमने भारत में 17 व विदेशों में 5 एकस्वों हेतु आवेदन किया है।

जब से सीएसआइआर ने 'सीएसआइआर नवाचार पुरस्कार' प्रारंभ किया है, तब से हमने दूसरी बार 'सीएसआइआर नवाचार पुरस्कार-2014' जीता है, जो *'एक सी सी गैसोलीन के C_4 हार्ट-कट से उच्च-शुद्धता वाली बेंजीन व यू एस-श्रेणी की गैसोलीन के युगपत् उत्पादन हेतु एक प्रक्रम'* हेतु प्रदान किया गया है। हमें यह पुरस्कार, प्रौद्योगिकी में अपनी साझीदार मै. रिलाइएंस इंडस्ट्रीज लि. के साथ प्राप्त हुआ। मुझे 'आइ सी सी डी एम् त्रिवेदी लाइफटाइम ऍचीवमेंट अवॉर्ड', भारतीय रसायन उद्योग में 2013 में अपने योगदान के लिए मिला। डॉ दिनेश चमोला, वरिष्ठ हिंदी अधिकारी को हिंदी में राष्ट्रीय स्तर पर उत्कृष्ट बाल साहित्य लेखन के लिए साहित्य अकादमी का प्रतिष्ठित 'बाल साहित्य पुरस्कार – 2014' दिया गया।

हमने इस वर्ष 70 से अधिक नई परियोजनाएं प्रारंभ की हैं जिसके लिए हमने भारतीय व अंतरराष्ट्रीय दोनों प्रकार के संगठनों से कई करारों व समझौता-ज्ञापनों पर हस्ताक्षर किए हैं, जिनमें से कुछ हैं: 'साबिक,' 'एनआरडीसी', 'दीपक नाइट्राइट,' 'ई आइ एल,' 'एन आर एल,' 'टेकनिप', 'हल्दिया पेट्रोकेमिकल्स,' 'ए ओ डी, डिगबोई,' 'भेल,' आदि। इस वर्ष हमने अभिलेखयोग्य 94 परियोजनाओं को सफलतापूर्वक संपन्न किया है जिससे हमारा 'बाह्य नकदी प्रवाह' अर्जन पुन: दहाई के अंकों, अर्थात रू 12 करोड़ तक जा पहुंचा है। मुझे यह उल्लेख करते हुए गर्व है कि इसमें से लगभग रू 8 करोड़ निजी, सार्वजनिक क्षेत्र की व विदेशी कंपनियों से अर्जित हुआ।

मुझे यह सूचित करते हुए प्रसन्नता है कि हमने उच्च विज्ञान-आधारित कुल 104 शोध-पत्र पीयर- समीक्षित जर्नलों में प्रकाशित किए हैं, जिनका औसत प्रभावोत्पादक कारक 3.85 है। वहीं दूसरी ओर इस वर्ष राष्ट्रीय व अंतरराष्ट्रीय सम्मेलनों/ संगोष्ठियों में 50 से अधिक शोध-पत्रों को प्रस्तुत किया गया। हमने प्रतिष्ठित अंतरराष्ट्रीय सम्मेलनों, यथा 'एस ए ई वर्ल्ड कांग्रेस,' 'ब्रैंकोन वीक,' 'डी जी एम के कॉनफ्रेन्स' में शोध-पत्र प्रस्तुत किए हैं और मुझे यह कहते हुए गर्व है कि मॉस्को, रूस में आयोजित सुप्रसिद्ध 'वर्ल्ड पेट्रोलियम कांग्रेस' में हमने पहली बार

मौखिक व पोस्टर शोध-पत्र प्रस्तुत किए।

नई दिल्ली में आयोजित 'इन्डो–रशन वर्किंग ग्रुप ऑव इनर्जी ऐण्ड इनर्जी एफिशिएंसी' की 19वीं बैठक के फलस्वरूप सीएसआइआर-ओपसं, देहरादून एवं जी सी ई ग्रुप, सेंट पीटर्सबर्ग, रूस ने संयुक्त रूप से हमारे संस्थान में नवंबर 28-29, 2014 के दौरान 'इनर्जी एफिशिएंसी एडवांसमेंट मेथड्स फॉर इण्डस्ट्रीज: ट्रेंड्स एण्ड इनोवेशन्स' विषयक एक कार्यशाला का आयोजन किया।

यह वर्ष कई विशिष्ट अतिथियों के आगमन के कारण भी एक उल्लेखनीय वर्ष रहा है। संस्थान का सौभाग्य रहा है कि यहां भारत रत्न प्रो. चिंतामणि नागेश रामचन्द्र राव, एफ. आर. एस. का 24 अप्रैल,2014 को आगमन हुआ। इस अवसर पर उन्होंने विज्ञान के इतिहास पर एक मंत्रमुग्धकारी व्याख्यान दिया और वैज्ञानिकों व विद्यार्थियों के साथ वार्तालाप का भी समय निकाला। इस वर्ष हमने अपना 54वां स्थापना दिवस अपनी संस्थापक संस्था अर्थात् आइ एफ पी के साथ मनाया। श्री ज्यॉर्ज पिका, कार्यपालक उपाध्यक्ष एवं मुख्य कार्यपालक अधिकारी, 'इंस्तीत्युत फ्रांसे दु पेत्रोल' (आइ एफ पी) तथा 'ऐक्सेन्स- आइ एफ पी ग्रुप टेक्नॉलॉजीज' ने विशेषत: इस अवसर हेतु फ्रांस से यहां तक की हवाई यात्रा की। उनके साथ श्रीमती योलांद रॉन्दो, उप निदेशक, अंतरराष्ट्रीय संबंध प्रभाग, श्री एरिक काप्रानी, प्रौद्योगिकी विकास निदेशक एवं श्री ज्यां-पॉल मार्गोतां, प्रबंध निदेशक, एक्सेन्स भी संस्थान में आए थे।

हमें डॉ. डी. एन्. रिहानी, पूर्व-कार्यपालक निदेशक, टेकनिप इंडिया लि., तथा श्री नरेन्द्र तनेजा, अध्यक्ष एवं राष्ट्रीय समन्वयक, ऊर्जा प्रकोष्ठ का, क्रमश: राष्ट्रीय प्रौद्योगिकी दिवस तथा सीएसआइआर स्थापना दिवसों पर मुख्य अतिथियों के रूप में स्वागत करने का गौरव भी प्राप्त हुआ।

हम पी सी आर ए व तेल कंपनियों के साथ संयुक्त रूप से 'तेल व गैस संरक्षण पखवाड़ा' मनाने की परंपरा जारी रखे हुए हैं। हमारा सौभाग्य था कि हम इस अवसर पर मा. मुख्यमंत्री, उत्तराखंड, श्री हरीश रावत व मा. मंत्री खेल, वन एवं वन्यजीव, विधि एवं न्याय, उत्तराखंड सरकार, श्री दिनेश अग्रवाल का भी स्वागत कर सके।

भारत सरकार के 'स्वच्छ भारत अभियान' की भावना के अनुसार समाज में जागरूकता फैलाने की दृष्टि से 2 अक्टूबर, 2014 को संस्थान के परिसर में एक स्वच्छता कार्यक्रम का आयोजन किया गया।

हमारे अधिदेश के अनुरूप एवं हमारी विशिष्ट स्थिति के कारण हम तेल उद्योग एवं संबंधित क्षेत्रों-यथा ऑटोमोबाइल उद्योगों एवं परिवहन क्षेत्र के कार्मिकों को महत्वपूर्ण प्रशिक्षण देने एवं उनके कौशल विकास में संलग्न रहते हैं। पेट्रोलियम परिष्करण प्रौद्योगिकी, वाहन प्रदूषण आदि विषयों के विभिन्न विषयों में पांच शोध छात्रों को पी-एच.डी/डी.फिल की उपाधियां प्रदान की गई ।

3 फरवरी, 2015 का दिन भी वास्तव में संस्थान के इतिहास में एक अविस्मरणीय दिवस रहेगा, क्योंकि इस दिन मैंने वैज्ञानिक तथा औद्योगिक परिषद के महानिदेशक के रूप में कार्यभार ग्रहण किया। मुझे विश्वास है कि अपने वैज्ञानिकों के सहयोग से मैं अपने अध्यक्ष एवं उपाध्यक्ष, सी.एस.आइ.आर. सोसाइटी की अपेक्षाओं को न केवल पूरा करूंगा, बल्कि उससे कहीं अधिक भी प्राप्त कर सकूंगा, चूंकि उन्होंने इस बड़े उत्तरदायित्व को वहन करने के लिए मुझ पर विश्वास और भरोसा किया है।

इस संस्थान व हमारे वैज्ञानिकों की उपर्युक्त असाधारण उपलब्धियां हमारे पणधारियों और हमारे वैज्ञानिकों व कर्मचारियों के सहयोग व शुभकामनाओं के बिना संभव न होतीं। मैं विज्ञान तथा सामाजिक सरोकार के प्रति अपने सभी पणधारियों, वैज्ञानिकों तथा कर्मचारियों की प्रतिबद्धता के लिए उन सभी का धन्यवाद करता हूं।

डॉ. मधुकर ओंकारनाथ गर्ग
निदेशक

From the Director's Desk.....

It gives me immense pleasure to present the Annual Report of CSIR-IIP for the year 2014-2015 highlighting our achievements and contributions. I am glad that the Institute has registered an exceptional all-round progress during 2014-2015; ranging from high science, translational research, technology development and commercialization, developing human resource, societal intervention and strengthening and extending our collaboration with industries.

I am happy to inform you that following our continuous and untiring efforts, we have bagged an order for the implementation of CSIR-IIP technology for installation of advanced internals in the soaker drum of the Visbreaking Unit at Haldia Refinery (IOCL); this is the third installation after HPCL Vizag and IOC Mathura. We have continued with our efforts to commercialise THOXCAT -ES catalyst for LPG sweetening both in India and abroad; there is an exciting opportunity ahead at Sohar refinery in Oman. We continue to make strong efforts to commercialise our technologies for waste plastics to diesel, bio-jet fuel etc. Maintaining our focus on IPR, we have been awarded 8 foreign patents and 5 Indian patents, while we have filed 17 patents in India and 5 patents abroad.

Ever since CSIR started the CSIR Innovation Award, for the second time, we bagged the CSIR Technology Award for innovation – 2014 for *'A process for simultaneous production of U.S-grade gasoline and high-purity benzene from C_6 heart cut of FCC gasoline'*. We received this award together with our technology partners, M/s Reliance Industries Limited. I was awarded the ICC D M Trivedi Lifetime Achievement Award for my contribution to Indian Chemical Industry, 2013. डॉ दिनेश चमोला, वरिष्ठ हिन्दी अधिकारी को हिन्दी में राष्ट्रीय स्तर पर उत्कृष्ट बाल साहित्य लेखन के लिए साहित्य अकादमी का प्रतिष्ठित बाल साहित्य पुरस्कार-2014 दिया गया।

We have taken up more than 70 new projects this year for which we have signed many agreements and MoU's with both Indian and international organisations: SABIC, NRDC, Deepak Nitrite, EIL, NRL, TECHNIP, Haldia Petrochemicals, AOD Digboi, GAIL etc., to name a few. A record 94 projects have been successfully completed this year with our ECF earnings again running into double-digit figure i.e. Rs 12 crores. I am proud to mention that out of this around Rs 8 crores are from Private, Public Sector and Foreign companies.

I am glad to inform that we have published a total of 104 high science-based research papers with an average impact factor of 3.85 in peer-reviewed journals whereas more than 50 research papers were presented in national and international conferences/seminars during the year. We have presented papers in prestigious international conferences, such as, SAE World Congress, Graphene Week, DGMK conference and I am proud to mention that for the first time we had both an oral and a poster paper in the famous World Petroleum Congress held in Moscow, Russia.

As an outcome of the 19th meeting of the Indo-Russian Working Group on Energy and Energy Efficiency held at New Delhi, CSIR-IIP, Dehradun and the GCE Group, St. Petersburg, Russia, organized a joint workshop on *'Energy efficiency advancement methods for industries : trends and innovations'* during November 28-29, 2014 at our Institute.

This year has been a landmark year for the Institute due to the visits of several dignitaries. The Institute was blessed with the visit of Bharat Ratna Prof Chintamani Nagesa Ramachandra Rao, FRS on 24th April, 2014 wherein he gave a fascinating lecture on history of science and took time out to interact with the scientists as well as students. This year we celebrated our 54th Foundation Day with our founder organization, namely, IFP. Mr Georges Picard, executive Vice-President and CEO, Institut Français du Petrole (IFP) and AXENS-IFP Group Technologies flew from France especially for this occasion and was accompanied by Mrs Yolande Rondot, Deputy Director, International Relations Division, Mr Eric Caprani, Technology Development Director and Mr. Jean-Paul Margotin, Managing Director, Axens.

We had the proud privilege of welcoming Dr D N Rihani, Ex-Executive Director, Technip India Ltd., and Mr Narendra Taneja, Chairman and National Convener, Energy Cell, as the Chief Guests for the Technology Day and CSIR Foundation Day celebrations, respectively.

We continue to organize the Oil and Gas Conservation Fortnight jointly with the PCRA and the oil companies. We had the honor to welcome Hon'ble Chief Minister of Uttarakhand Shri Harish Rawat along with the Hon'ble Minister of Sports, Forests and Wildlife, Law & Justice, Govt. of Uttarakhand, Mr Dinesh Agarwal.

In line with the GOI's Swacch Bharat Abhiyan, to create awareness in the society, a cleaning drive was initiated on 2nd October 2014 within the campus of the Institute.

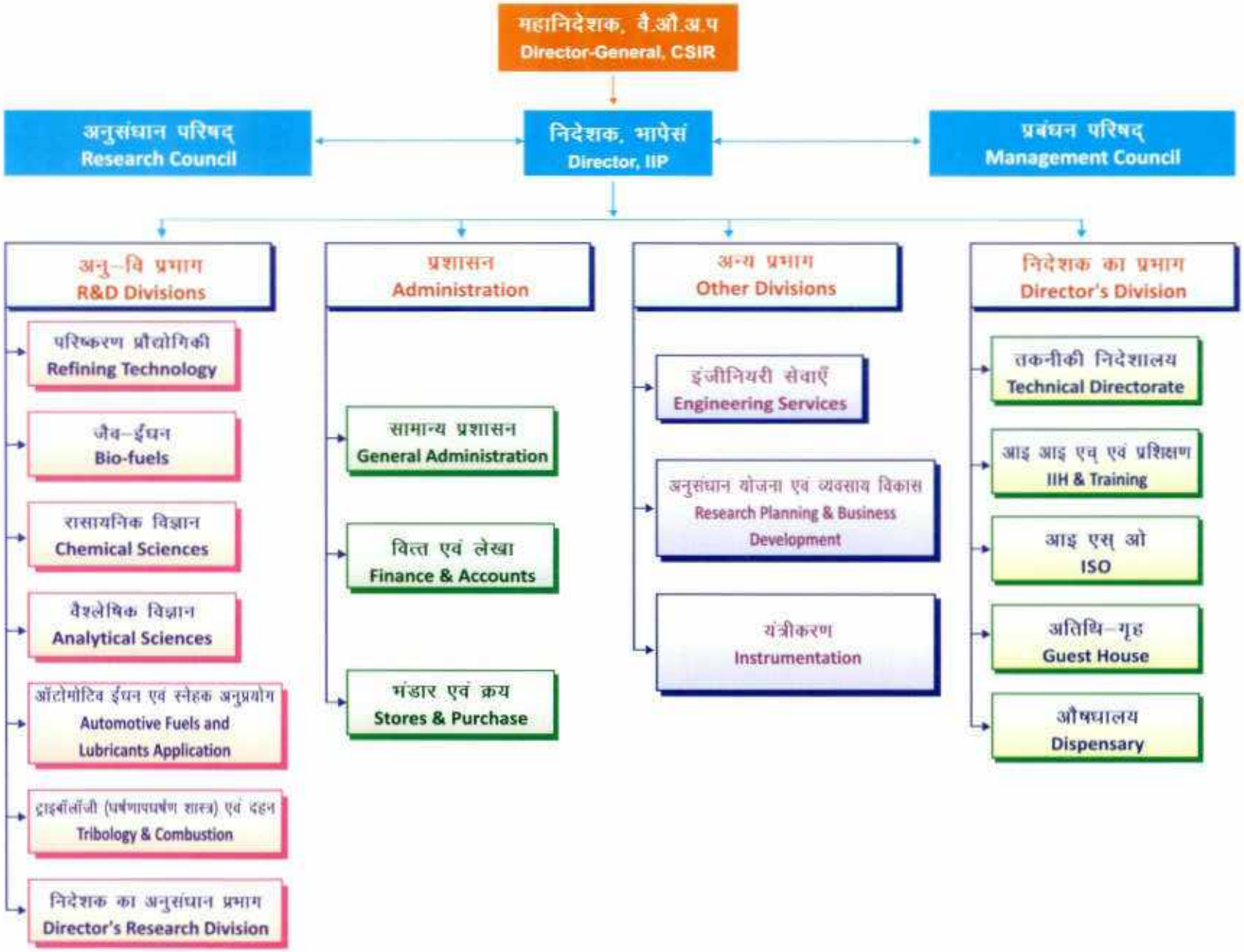
As per our mandate and our unique position, we continue to provide valuable training and skill development to the personnel from the oil industry & related fields such as the automobile industry and the transport sector. A total of 15 training courses were conducted in petroleum refining technology, vehicular pollution etc. Five research scholars were awarded PhD/ DPhil degrees in various disciplines of science.

February 3, 2015 was indeed a landmark day in the history of our Institute when I took over as the Director-General of CSIR. With the support of my scientists, I am sure that I will be able not only to meet, but, also to exceed, the expectations of our President and Vice-President of the CSIR Society, who have put their faith and trust in me to shoulder this huge responsibility.

The above extraordinary achievements of this Institute and our scientists would have not been possible without the support and well wishes of our stake-holders and the untiring efforts by our scientists and the staff. I thank all our stake-holders, scientists and the staff for their help and commitment to science and societal intervention.

(Dr Madhukar Omkarnath Garg)
Director

संगठनात्मक चार्ट / ORGANIZATIONAL CHART

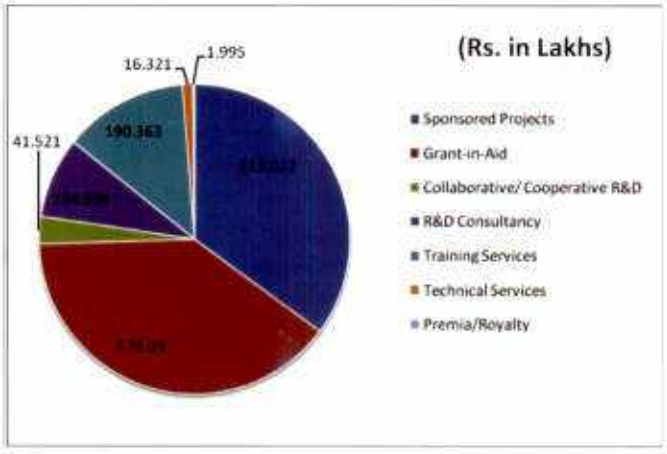


उपलब्धियाँ एक नज़र में : शोध–पत्र एवं एकस्व
ACHIEVEMENTS AT A GLANCE : PAPERS & PAENTS

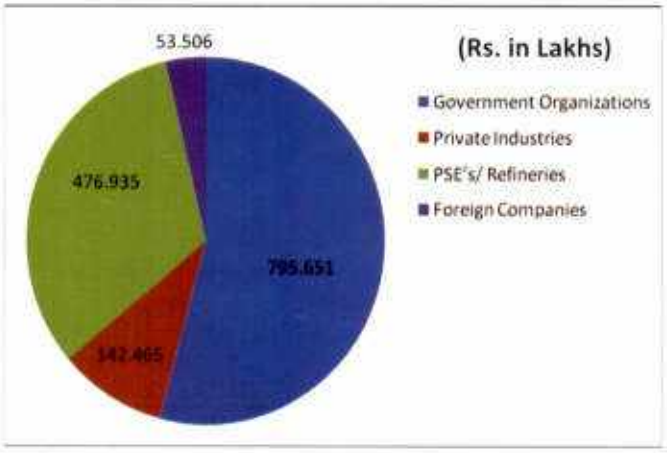
Papers in Journals	**104**
Papers in Indian Journals	3
Papers in International Journals	101
Papers in SCI Journals	92
Papers in Non-SCI Journals	12
Average Impact Factor	**3.85**
Papers Presented in Conferences	57
Number of Persons who attended Seminars/ Conferences	51
Number of Patents Filed in India	17
Number of Patents Filed Abroad	8
Number of Patents Sealed in India	5
Number of Patents Sealed Abroad	9

बाह्य नकदी प्रवाह से वित्तीय वर्ष 2014–15 के दौरान सीएसआइआर–भापेसं की आय : रू० 1202.80 लाख
The CSIR-IIP's ECF during the Financial Year 2014-2015 : Rs 1202.80 lakhs.

परियोजनावत् / Project-wise



क्षेत्रवत् / Sector-wise



1

विज्ञान एवं प्रौद्योगिकी में योगदान

Contribution to SCIENCE & TECHNOLOGY

1.1 परिष्करण प्रौद्योगिकी/Refining Technology

1.1.1 ऍरोमैटिक निष्कर्षण/Aromatic Extraction

- **Support on BDEP and Commissioning the Technology: Simultaneous Production of Pure Benzene and US Grade Gasoline from FCC C_6 Heart Cut (Deisohexaniser side cut)**

Worldwide, there is continuous thrust to reduce benzene content in gasoline as a part of the clean air programme. Gasoline specifications of benzene in US have been revised to maintain 0.62 vol.% maximum, effective from 2011. Typical streams used at Jamnagar, RIL for blending in gasoline pool are reformate, FCC gasoline, straight-run naphtha, alkylates, hydrocracker light naphtha, TAME, etc. Out of these, FCC gasoline is the major contributor of benzene in the gasoline pool. The normal process to remove benzene from FCC gasoline is to saturate them using any of the commercially available technologies such as BenSat, BENFREE, CDHYDRO, etc.

Looking at the high severity FCC operation at Jamnagar, RIL; through-put, margin between gasoline and benzene, etc., it is economically attractive to extract high-purity benzene from FCC gasoline instead of saturating it.

CSIR-IIP had done 'Proof of concept' (POC) study for FCC gasoline select cut (Reliance SEZ DIH side cut sample) to extract benzene and established appropriate process to scale it up for commercial design.

After POC, further experimental as well as simulation studies were carried out to fine tune the end product purity, yield and other operating parameters.

CSIR-IIP could achieve targeted specifications of US-grade gasoline in the raffinate product and simultaneous production of benzene-rich extract (benzene >95 mass%) was also feasible. Finally, the CSIR-IIP submitted an exhaustive Technical Information Package to RIL on completion of the project. The CSIR-IIP team participated in BDEP and Detailed Engineering alongwith Technip, New Delhi and RIL. Plant commissioning based on the technology is expected by September, 2015.

- **Upgradation of Residual Fuel Oil using non-HDS Route such as Oxidation/ Solvent Extraction**

Residual fuel oils (RFO) are the products produced by blending residues obtained from various processes of a refinery, such as the mixture of vacuum-flashed VB residue, atmospheric VB gas oil, vacuum residue from high-sulphur crude, PDA pitch, heavy extracts etc. Hence, RFO may contain significant quantities of impurities such as asphaltenes (3-10%), nitrogen (0.25-0.6%) and sulphur (3-5.5%) along with some metals. The high level of impurities in the residual fuel oil are a hindrance to catalytic reactions as these impurities poison the catalyst and are responsible for coke production. Fuel oils have a broad range of volatility and viscosity. Hence, processing of residual fuels to meet the required specifications by hydrodesulphurization will pose problems. Since fuel oil is also used on board ships to generate the powers to the engine, therefore it is also known as bunker fuel. Disposal of this product as such in the future poses a problem to the environment.

Air pollution considerations are important in determining the allowable sulphur content of fuel oils. Sulphur content is frequently limited by legislation aimed at reducing sulphur oxide emissions from the combustion equipment. These laws require sulphur content to be below a certain level, usually 1.0, 0.5, or 0.3%. Hence specifications of residual fuel oil become increasingly stringent with respect to sulphur content.

Considering future specifications of residual fuel oil (RFO) & the limitations of HDS process, there is an urgent need for development of an innovative process based on non-HDS route. This will also help in saving hydrogen in enormous amounts and subsequent reduction in green house gases.

Following activities were carried out under this project

- Extraction runs at 70 °C were carried out in a glass mixer settler reactor with different streams of residual fuel oil (RFO), e.g. Vistar, containing ~ 6% total sulphur, Vacuum residue (VR), Light Extract, Heavy extract, gas oil and combination of Vistar and

Extraction Studies of Oxidized GO (S = 1.47 %)

RHC – Raffinate Hydrocarbons (Solvent-free Basis), S/F = 1 w/w, Temperature 70 °C

S.No.	Solvent used	RHC, sulphur wt%	RHC Yield, wt%
1	NMP+3% H_2O	0.18	73.06
2	Acetonitrile	0.19	70.37
3	TMP	0.23	87.94

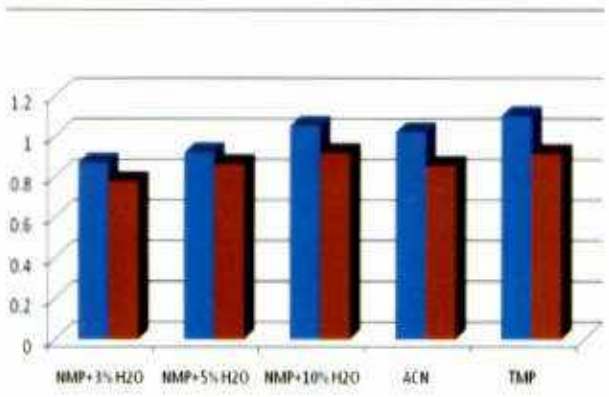
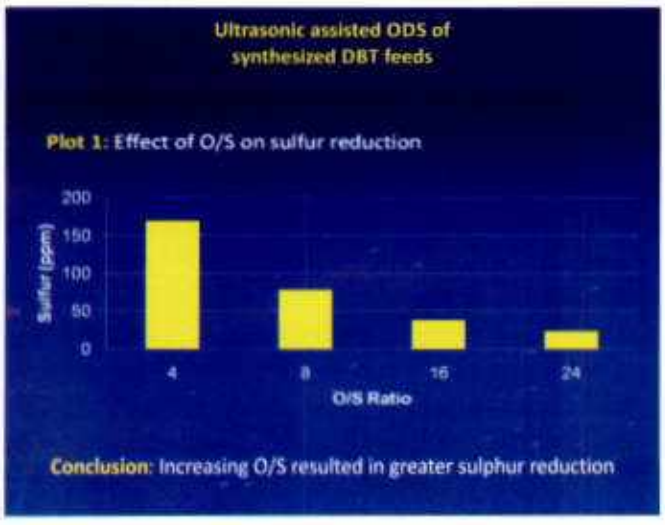


Figure-1: Effect of various solvents on extraction of gas oil stream

Microwave-assisted ODS of Vistar + GO (60:40) wt% sulphur feed = 4.44 wt.%

S. No.	Energy in Watts	Time (min)	Feed/ Oxidant Ratio	Sulphur in RHC (wt%)	Yield %
1	500	60	1.0	1.29	48.2
2	600	30	0.5	1.36	39.0
3	600	30	1.0	1.16	38.0
4	750	30	1.0	1.33	50.2*
5	900	60	1.0	0.93	43.6
6	No MW	60	1.0	0.88	33.5

[Oxidized samples were washed and extracted using NMPT+30% as extraction solvent , SIP=1w/w; * NMP + 10% water extraction solvent]



VR with gas oil (viscosity cutter) and different aqueous solutions of solvents e.g. NMP, DMF, Acetonitrile etc.

- Oxidation runs at 70 °C were carried out in a glass mixer settler reactor with different streams of residual fuel oil (RFO) e.g. Vistar containing ~6% total sulphur, Vaccum residue (VR), gas oil and combination of Vistar and VR with gas oil (viscosity cutter). Oxidation runs were followed by extraction with non-polar (n-Heptane or n-Decane) followed by extraction of oil phase by polar solvents e.g. aqueous solution of solvents viz. NMP, DMF, Acetonitrile etc.
- Batch LLE data completed with various solvents and feed mixtures
- Oxidative Desulphurization study carried out
- Oxidative Desulphurization study carried out in the presence of external field microwave and ultrasound followed by extraction with non-polar and polar solvents.
- The final report is under preperation

- **Establishing Proof of Concept For Processing Straight-run Naphtha for Recovery of Naphthenes And Aromatics**

Following steps were involved in the process:

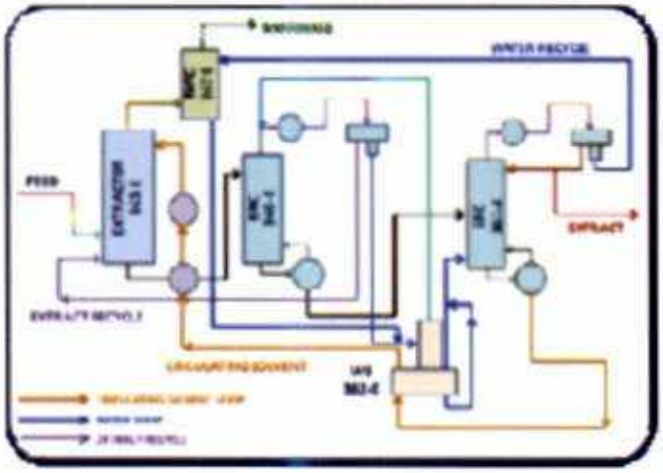
- Characterization of feedstock
- Continuous counter-current extraction column runs (using the same process operating conditions as used in the simulation model)
- Preliminary simulation had been performed using the procured feedstock

- **Fine-tuning Process Simulation Model**

- The experimental results obtained were compared with results of the preliminary simulation model
- Continuous counter-current extraction column runs were conducted to verify the simulation-derived process operating parameters and results.

Recovery of naphthenes and aromatics by separation of a naphthenes- & aromatics-rich extract stream (lean in paraffins) and a paraffins-rich raffinate stream (lean in naphthenes and aromatics) from straight-run naphtha / or similar feedstocks using solvent extraction route was achieved. Data were presented to M/s SABIC, Europe at

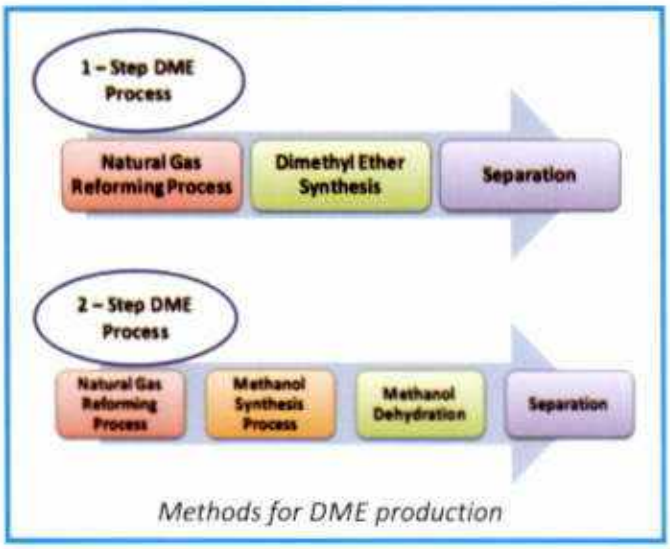
M/s SABIC, the Netherlands by the CSIR-IIP team. M/s SABIC were satisfied with the outcome of the study. The final report was submitted to M/s SABIC, Europe.



1.1.2 गणितीय प्रतिरूपण एवं अनुकरण/ Mathematical Modelling and Simulation

- **Mini DME – A Custom-Designed Solution to Bring Stranded Gas to the Energy Markets**

This project would be undertaken by an Indian and Australian consortium including the CSIR-Indian Institute of Petroleum (IIP), Bharat Petroleum Corporation LTD (BPCL), the IIT-Roorkee (IIT-R), CSIRO, The University of Melbourne (UoM) and RMIT University, with the IIP and CSIRO acting as the co-ordinating institutions in India and Australia respectively. The modelling and simulation of DME process for selection and the development of DME process are major activities being carried out in modelling and simulation area. DME can be produced by two distinct methods, namely, methanol synthesis from synthetic gas, followed by its dehydration (Indirect route: 2 steps) and directly from synthesis gas in a single stage using bi-functional catalysts (direct route: 1-step).



Methods for DME production

In this project, kinetic modeling & simulation of the processes involved in DME production with the aim of developing the kinetic model required for designing of the reactors, improving the process energy efficiency and

Table 1. Process summary for 10TDP DME plant

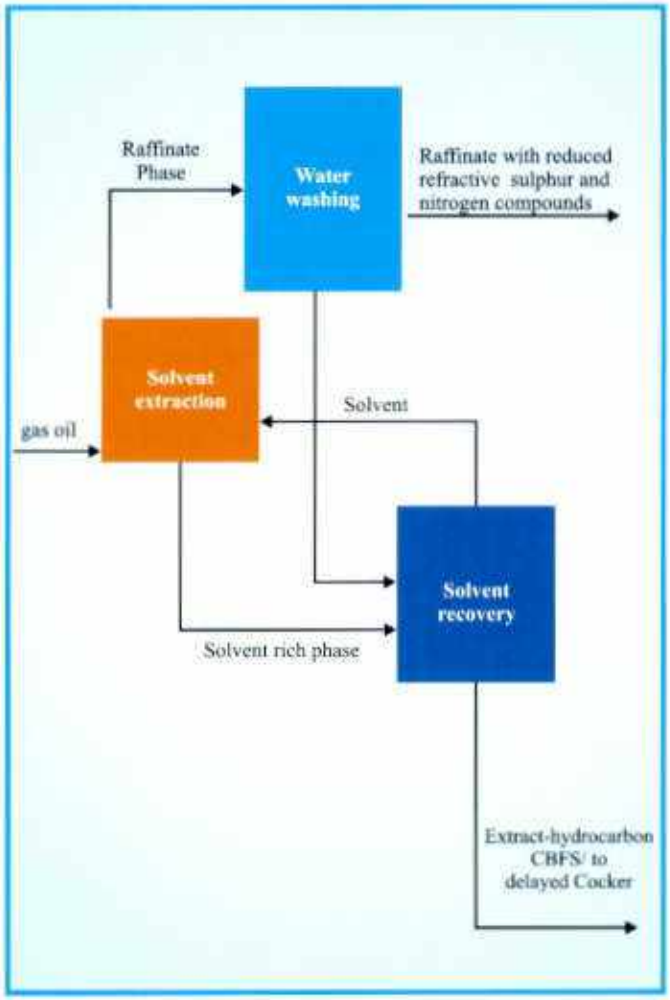
Output parameter	Value
Specific Methanol production rate (kmol methanol/kmol CH_4)	0.84
Specific DME production rate (kmol DME/kmol CH_4)	0.4975
Specific energy requirement (kW/kmol DME)	38.35863
Specific CO_2 footprint (kmol of CO_2/kmol DME)	0.2156
Reformer per pass conversion	95
Methanol reactor per pass conversion	62.88
DME reactor per pass conversion	80.45
Need for separation train	Yes
Need for compression	Yes
Specific oxygen requirement (kmol O_2/kmol DME)	1.217
Specific water requirement (kmol H_2O/kmol DME)	0.0133

lowering the green house gases emission was carried out. Operational parameter sensitivity analysis for methanol and DME reactors reveals that the performance of the reactor strongly depends on H_2/CO ratio,$(H_2-CO_2)/(CO+CO_2)$ or R-Value ratio, CO_2 % in feed, temperature and pressure and have great impact on the yield, selectivity of DME and economics of the whole plant. The separation steps involved were simulated using the simulation model interaction parameters which were fine-tuned using the vapor-liquid equilibrium. The data reported in literature to assure the simulation results are reliable.

Kinetic models of reforming processes such as steam reforming, autothermal reforming and catalytic partial oxidation, used for syngas generation, were developed in ASPEN PLUS V8.4 using the reported kinetic data in various papers. Methanol synthesis and methanol dehydration kinetics models were also developed in ASPEN PLUS V8.4 using reported data. After proper validation of kinetics model with literature data and conceptualization of process flow scheme with the recycle loops, simulation of complete process (ATR + 2-Step) for 10 TPD DME plant was carried out to generate material and energy balance. The separation train required to separate the effluent from methanol reactor and DME reactor were also simulated. The over-all process summary for 10TDP DME plant is given in Table 1.

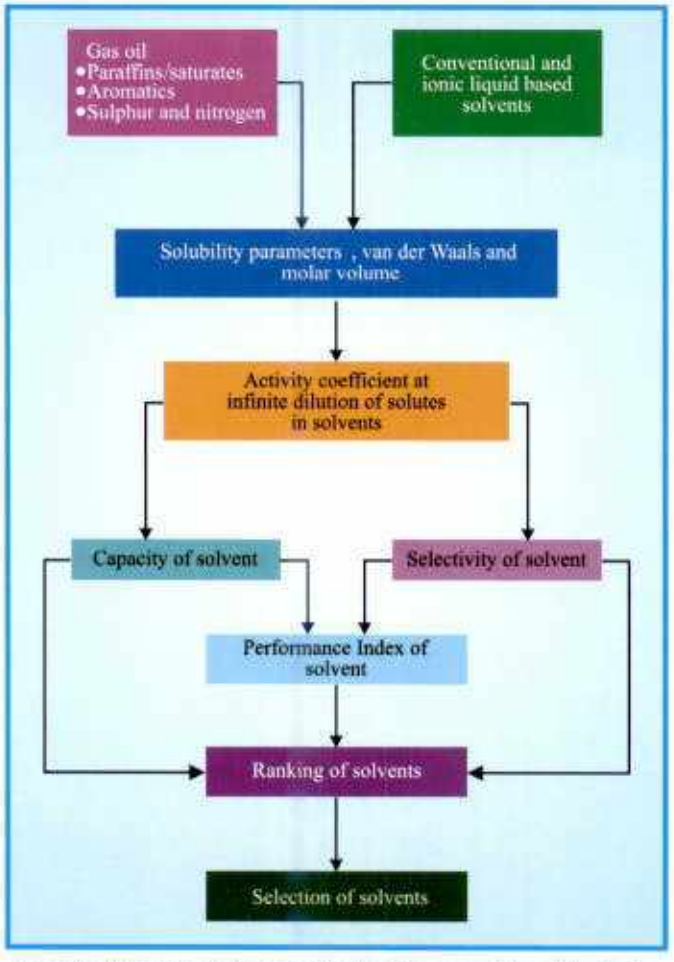
- **Molecular Modelling and Simulation application in Hydrocarbon Science & Technology**

The focus of this project in modelling and simulation was on evaluation and design of conventional and non-conventional solvents for sulphur and aromatic removal from gasoline and gas oil. Gas oil consists of a mixture of paraffins, cycloparaffins, aromatics, sulphur and nitrogen compounds along with metal impurities. The presence of aromatics, sulphur and nitrogen compounds in gas oil generates hazardous emissions in the environment and adversely affects the performance of emission control technologies during its combustion in the engine. This compels the oil industries to produce the sulphur, nitrogen and poly-aromatics-free gas oil. Hydro-processing is the most widely used commercial process to remove these impurities. However, for deep removal of undesired compounds very severe operating conditions are required which result in huge investment and operational cost in hydro-processing. Therefore, refiners are looking for development of less energy- and capital-intensive (either alternative or complementary) methods for production of ultra-clean gas oil. Solvent extraction which operates at mild temperature and pressure can be used as complementary process to produce clean gas oil with lower capital and operational costs. A schematic of solvent extraction process is given in the figure below.



Schematic diagram of gas oil solvent extraction process

Selection of a suitable solvent is of great importance in solvent extraction as it governs quality of products and also controls the initial and operational investment of the process. The success of the commercial process depends on the performance of the solvent in extraction process. For evaluation of organic and ionic liquid (IL) solvents for gas oil desulphurization a new strategy was conceptualized (Figure on next page).



A novel strategy for evaluation of solvents for gas oil desulphurization

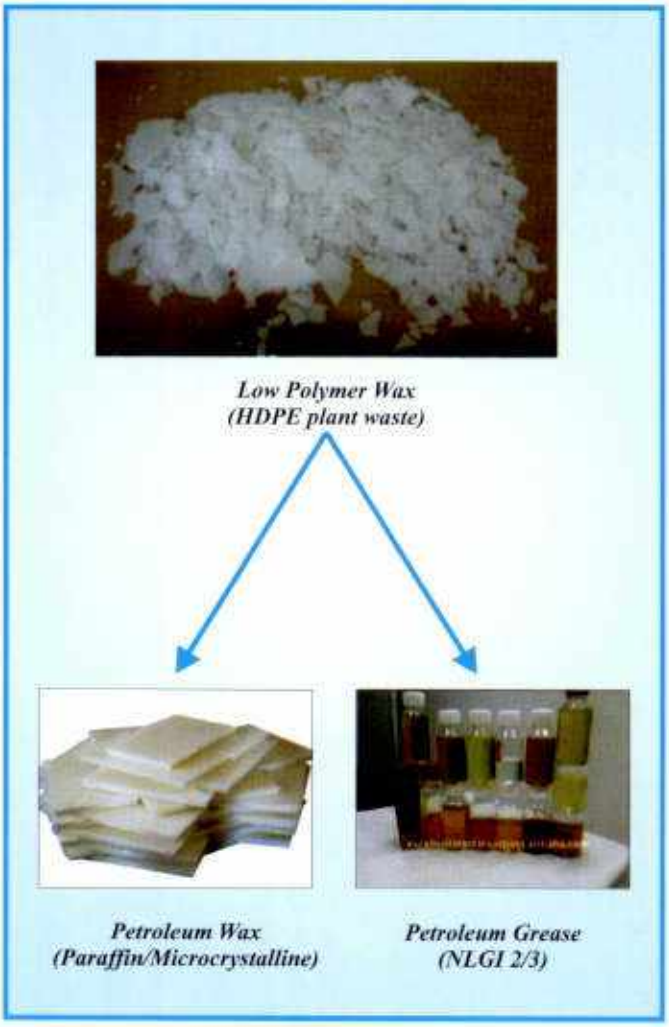
1.1.3 मोम प्रवाहिकी/Wax Rheology

- **Conversion of Waste Plastics to Automotive Fuels and Aromatics : Preparation of Basic Design Engineering Package and cost estimation for 10 TPD**

The Institute alongwith GAIL (India) Ltd. developed a novel process for converting waste plastics, particularly polyolefins, to value-added products like automotive-grade fuels (gasoline and diesel) and petrochemical feedstocks. The proccess has been successfully validated at bench scale (feed capacity 7-8 kg per day). To promote commercial activities, a Basic Design Engineering Package (BDEP) was prepared and the cost of plant estimated with a + 30 % accuracy.

- **Bench-Scale Study for Conversion of Low Polymer Wax (LPW) to Waxes and Greases**

Low-polymer wax or polymer mud is a low-value by-product obtained in certain HDPE manufacturing units. A feasibility study carried out earlier with the objective of adding value to this by-product shared that paraffin wax, micro-crystalline wax and grease can be obtained from these. A bench-scale study was taken up with the objective of setting up a full-fledged continuous unit (3-5 kg/hr) for conversion of low-polymer wax (LPW) to waxes and greases for establishment of process parameters, improvement in quality and yield of products and obtaining detailed material and energy balance as well as kinetic parameters.



- **Feasibility Study for Producing Specialty Waxes**

A specialty wax from indigenous sources is required for defense purposes, for which the Institute took up a feasibility study to investigate whether this particular specialty wax can be produced from indigenous sources.

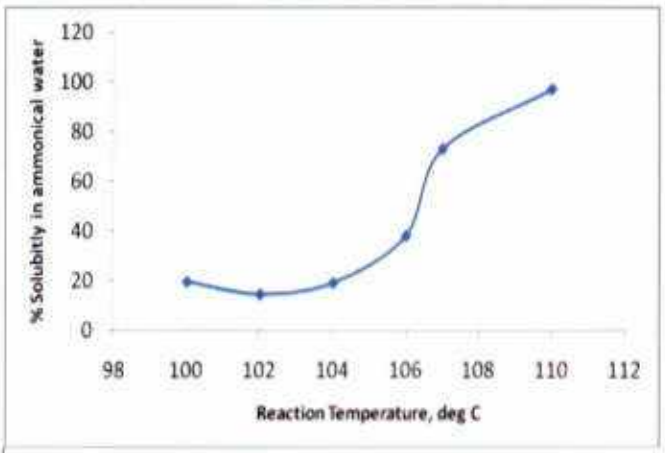
1.1.4 मधुरण/ Sweetening

- **Development and Commercialization of New Ammonical Water-Soluble Fixed-Bed Sweetening Catalyst**

a. Synthesis of fixed-bed sweetening catalyst samples at different operating conditions

Main objective of the project is to develop a new catalyst useful for fixed bed sweetening of cracked gasoline/ kerosene/ATF, which can be impregnated on activated carbon bed by using dilute aqueous ammonical solution. Around 30 batches of catalyst were so far made. Solubility was taken as a criterion for establishing its probable activity and preliminary screening basis. It was observed that 107 deg C catalysts appeared to be the most likely ones. A detailed run was also given with our established catalyst at 110 deg C.

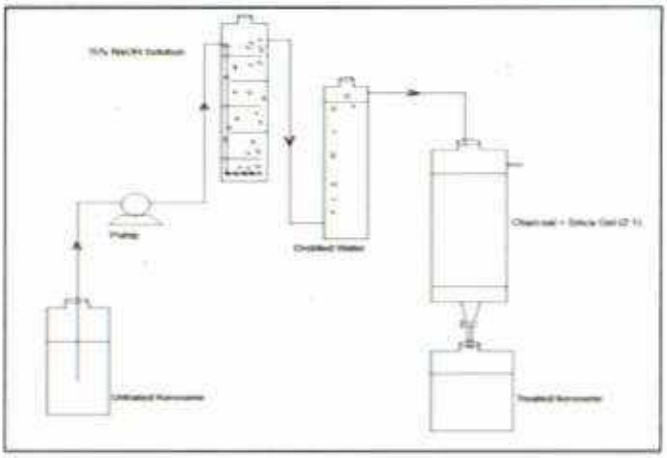
The trends of the solubility obtained are shown below:



Solubility plot (avg) of catalysts as a function of Reaction Temperature

b. Design and set-up of pre-treatment unit for kerosene

The glass set up for pretreatment of naphthenic acid of kerosene fraction by alkali wash using 15 wt% NaOH followed by water wash and final tuning by carbon and silica gel bed was fabricated to prepare feed for pilot plant studies. The treated kerosene was colourless with RSH level less than 10 ppm. The doping of this pre-treated kerosene is to be done by t-dodecyl mercaptan upto 300 ppm.



Set up for pre-treatment of kerosene for reduction of TAN

c. Pilot plant runs

The pilot plant in which experiments were carried out successfully is in the figure below. Pilot plant run was given with commercial catalyst for comparative performance which was found to be comparable. However, with higher solubility the bed had significant leaching resulting in poor performance.

Pilot plant for fixed-bed sweetening catalyst

The experimental conditions were:

- Impregnation of 107 deg C (4h) and 110 deg C(4h) catalyst
- Bed Alkalinization with 7 wt % caustic
- Run with 280-310 ppm feed

- LHSV = 1, 2, 4, 6, 8 h^{-1}
- Temperature = 45+/- 2.5 deg C
- Pressure = 7 kg/cm^2 g

d. Catalyst issues being addressed

The catalyst batches had shown variation in solubility from batch to batch. The matter was analysed based on FTIR spectra and on the basis of CHNS results. It was found that the ones with solubility of close to 65% were mostly having tri-substitution and the ones with lower solubility were having di-substitutions. Accordingly, the problem was investigated in 2-5 gm level. The variation of this solubility could be attributed to disintegration of sulphonyl chloride in aqueous environment especially when temperature is above 5 deg C. Hence, a number of batches were carried out by studying the effect of various parameters like:

- Sulphonation temp and time
- Ammidation temp and time
- Aqueous minimized environment
- Temperature of drying

Sulphonation time and ammidation time were found to be important parameters during this investigation. Further studies are presently under way.

e. Progress review meetings

Two progress review meetings were held during this period. One in August 2014 and the second in March 2015. The project scope did not initially include pilot plant activities at the CSIR-IIP. However, since the BPCL wanted pilot plant activities to be conducted in the Institute, the pilot plant was designed and procured. It was to be accounted for in terms of time and project money. BPCL accordingly signed a fresh MoU with the CSIR-IIP for this additional work. The project tenure was accordingly extended by 1 year.

- **Commercialization of Catalyst Thoxcat ES for Sweetening of LPG**

➢ An order for 600 kgs of Thoxcat ES is expected by our licensee M/s Lona industries from M/s Sohar Refinery through M/s Special Oilfield Services, Muscat.

➢ M/s Essar is expected to commercialise our Thoxcat ES catalyst. Comparative performance of Thoxcat ES with catalyst from Essar is done in the laboratory.

- **Development of a New-Generation Solid Basic Oxide or Hydrotalcite Supported Catalyst for Fixed-Bed Sweetening Of Heavier Petroleum Fractions**

The main objective of this project is to develop cobalt phthalocynine-based catalyst supported on solid basic oxide or Mg-Al hydrotalcite useful for alkali-free sweetening petroleum fractions like kerosene, ATF or thermally/catalytically cracked gasoline.

1. Magnetically separable bi-functional catalysts composed of cobalt phthalocyanine supported on magnetic core-shell structured Mg–Al hydrotalcite solid base have been synthesized.
2. The developed heterogeneous catalyst was used for the oxidation of thiols to disulphides by using molecular oxygen as oxidant under alkali-free conditions.
3. Alkali-free oxidation of heavier petroleum fractions like kerosene blended with C_{12} mercaptan was tested by using the developed heterogeneous catalysts.

- **Mechanistic Kinetics Studies of LPG Sweetening Process**

The objective of the project is Mechanistic Kinetics Studies of LPG Sweetening Process using our Thoxcat ES catalyst

The main objectives of the proposed work are:

- To develop independent capabilities to explain the reaction mechanisms involved in LPG sweetening processes
- To study hydrodynamics of LPG Sweetening Oxidizer
- To study the LPG-range thiol catalytic oxidation mechanisms and its kinetics; *in-situ*
- To obtain the mechanistic rate law of catalytic thiol oxidation.

An EOI prepared for the chemical laboratory prepared accordingly for *in-situ* studies as well, so that it may be procured as an add-on after the reactor order is placed.

1.1.5 गैस पृथक्करण/Gas Separation

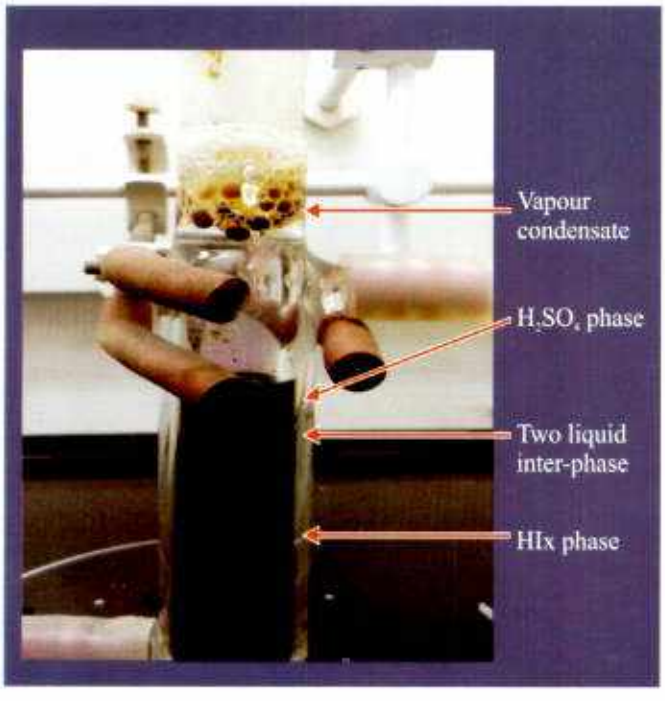
- **Carbon-free Hydrogen Production using H_2S in Petroleum Refinery**

Carbon-free hydrogen production using H_2S at refineries to arrive at optimized conditions in order to achieve

better economics of the process was the object of this study.

The following noteworthy breakthroughs were achieved:

- Standardization of analytical procedure by the following scheme:
  - i. Analysis of total acidity of the liquid through neutralization titration using NaOH
  - ii. Analysis of sulphate by either using ion chromatograph or by indirect titration of excess $BaCl_2$ with EDTA after precipitation of $BaSO_4$
  - iii. Analysis of iodine by redox titration
  - iv. Iodide analysis by ion chromatograph and cross checked with the values obtained from steps (i) and (ii).
  - v. Water amount measurement from over-all material balance
- Establishment of two liquid-phase separation characteristics for Bunsen reaction adding different fractions of iodine with a total liquid volume of 15 ml. Fig. 1 shows the photograph of two phases separately, namely H_2SO_4 phase at the top and the HIx phase at the bottom.



Phase separation of Bunsen reaction products upon addition of excess iodine

- **Post combustion CO_2 Capture: Development of Solvent System for Conventional and Phase-change Absorption Processes**

The major difficulties of using conventional amine solvents for CO_2 capture from flue gas streams are high energy requirement, large solvent circulation rate and high solvent degradation rate, all of which lead to higher operating and capital cost when CO_2 capture is implemented in process, especially in power plants. This leads to very low motivation for the implementation of CO_2 capture and sequestration (CCS) in power plants. Hence, the major focus on global R&D in this area is on developing better solvent systems with the sole objective of reducing the cost of capture. Phase change solvents may be a very good alternative to the existing one. In accordance, the primary objectives of this work are the following:

- Screening of phase-change solvent systems through rigorous experimental investigation
- Measurement of reaction kinetics and VLE with selected solvent(s)
- Comparison of performance with conventional solvents
- Development of comprehensive kinetic-mass transfer-equilibrium coupled absorption rate models

Following breakthroughs were achieved:

- Screening of solvents
- Fabrication of experimental set-up

1.1.6 गैस–से–द्रव/Gas-to-Liquids (GTL)

- **Development of Catalyst for Production of Syngas from CO_2 and Methane**

Keeping in view of the global trends and the national scenario for utilization of Carbon dioxide in an economical way, It was proposed to develop a catalyst for production of Syngas from CO_2 and Methane in a lab scale study.

Catalyst preparation was undertaken considering the economy of raw materials and preparation method. The catalysts were prepared by sequential incipient impregnation method and the physico-chemical properties of fresh and used catalysts were thoroughly studied.

Ni-based catalysts supported on single as well as mixed oxides were prepared and initial activities were checked for dry reforming. Reaction studies were carried out on a

high temperature micro-flow fixed-bed reactor unit. Based on the feedback from the activity and analytical characterisation studies, the catalysts were modified with suitable promoter metals. It was observed that deposition of carbon nano filaments on the catalyst blocked the active metal sites and thereby decreased the conversions of both Methane and CO_2 and simultaneously increased pressure drop in the catalyst bed that led to the shutdown of the reactor. Regeneration studies were also be carried out in order to remove the deposited coke but, as most of the coke was the kind of graphitic form, hence it could not be effectively regenerated.

Later, tri-reforming reactions were carried out on the promising catalysts identified in dry reforming. The catalysts were again modified after the initial screening tests. Long term stability studies were carried out on the selected catalysts. A catalyst formulation GDT-7T has shown stable performance upto around 300 hrs with negligible pressure drop in the catalyst bed. Fig.1 shows the visibility of carbon through SEM profiles of used catalysts for dry and tri-reforming, where the tri reforming catalysts showed negligible presence of carbon formation. Fig.2 shows the stability of various catalysts for tri reforming reaction studies. Among the catalysts GDT-7T was found stable.

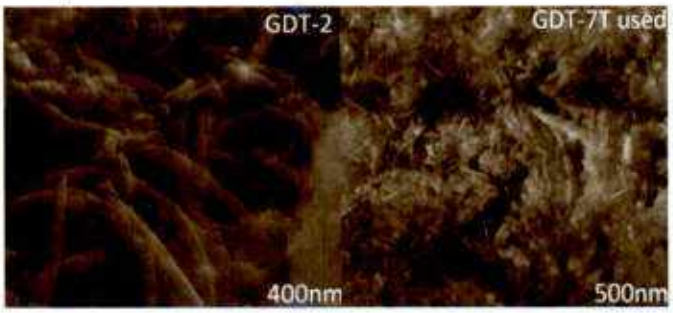


Fig.1 SEM micrographs of GDT-2 and GDT-7T used catalysts for dry reforming and tri-reforming, respectively

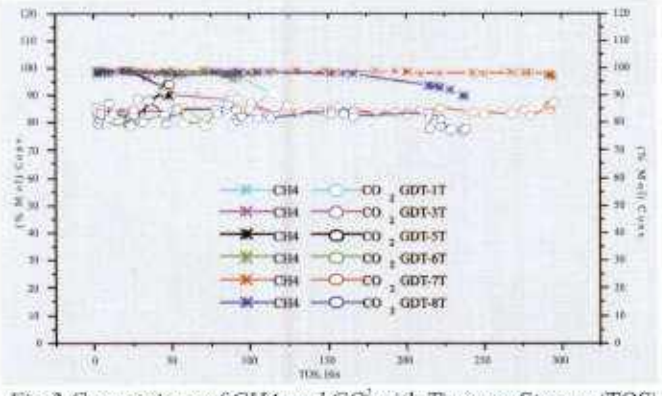


Fig.2 Conversions of CH4 and CO2 with Time-on-Stream (TOS) of various catalysts for tri-reforming of methane

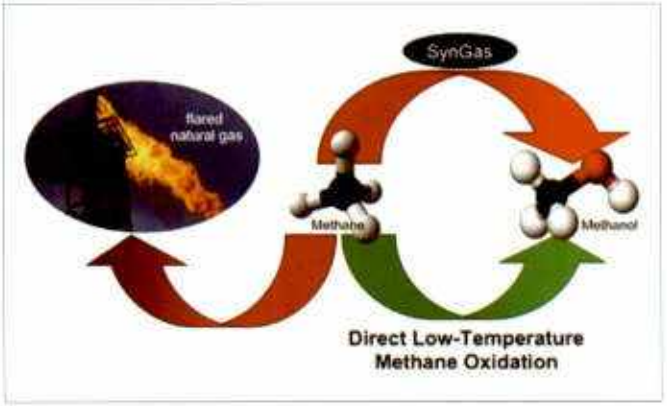
- **Direct Conversion of Syngas Selectively to Dimethyl Ether (DME)**

Recent research trends are that CO_2 is being used in the Syngas generation step by CO_2 reforming of Methane. Here the Syngas thus produced is used for the DME production. DME is a versatile chemical which can be used as high cetane fuel, substituent to domestic cooking gas, aerosol propellent and for power generation. Direct Syngas to DME using a suitable stable bi-functional catalyst is more favourable than conventionally operated equilibrium limited two-step (Syngas to methanol and further to DME) processes. There are no commercially available technologies for this single-step process.

Various catalyst recipes were prepared and their physico-chemical characterization studies are under progress.

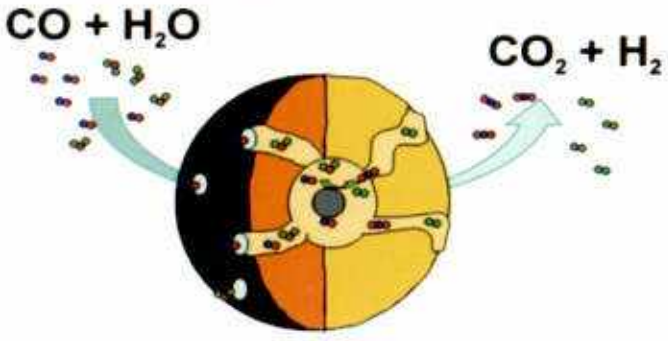
1.1.7 नैनो–उत्प्रेरण/Nano-Catalysis

- **Selective Oxidation of Methane to Methanol over Supported Nano-Clusters**



Preparation of nano-clusters where the particle size is below 1 nm appears the most challenging research in terms of preparation, characterization and potential enhancement of reactivity. The development of such novel material is a fundamental focal point of chemical research; and this interest is mandated by advancement in all areas of industry and technology. Methane is the most abundant and the least reactive of the hydrocarbon family, thus the selective oxidation of methane to methanol is one of the most challenging chemical problems, in addition to being of great practical importance. We have developed Cu-nano-clusters (size below 1 nm) supported on nano-crystalline MnO_2 catalyst which can selectively convert methane to methanol at atmospheric pressure with molecular oxygen to get ~ 6% methane conversion with ~ 52% methanol selectivity.

- **Low-temperature Water-Gas-Shift Reaction over Pt-Nanoclusters Supported on CeO_2**



With the recent development and beginning of commercialization of polymer electrolyte membrane fuel cell (PEMFC) the demand of CO-free hydrogen has increased to a great extent. In fact, the development of a technology for production of pure hydrogen (with little or no CO) conventionally and at a low cost is one of the challenges posed to hydrogen-economy sector. Conventionally, water-gas-shift (WGS) reaction, $CO + H_2O = CO_2 + H_2$, is applied in most hydrogen production facilities to decrease the concentration of CO and to increase simultaneously the production of H_2. The supported Cu-nano-clusters were prepared hydrothermally in the presence of surfactant known as cetyltrimethylammonium bromide. It has been observed that the small Cu-clusters supported on CeO_2 are active for the water-gas-shift reaction. It is very interesting to note that when a small amount of Pt (0.5wt %) was added to these catalysts, the activity increased dramatically. Pt/Cu-Ce shows a CO conversion of 92.8% after 0.5 h reaction time at 423 K

- **Dehydrogenation of Ethane to Ethylene over Nano-Crystalline TiO_2**

Ethylene is a very important chemical, which does not occur in nature but still represents the organic chemicals consumed in greater quantity worldwide. It is mainly the raw material for the large number of industrial products, such as poly-ethylene, polyvinyl chloride, polystyrene, polyester, etc. Despite the economic uncertainty around the petro-chemical industry, ethylene production and consumption scenario are expected to grow continuously. The global demand of ethylene is over 140 million tonnes per year with the future growth rate of 3.5% per year. We have successfully developed a nano-catalyst containing TiO_2 nano-rod-supported Mo or Rh nano-particles, which shows an ethane conversion of ~92% with ~85% ethylene selectivity at 973K.

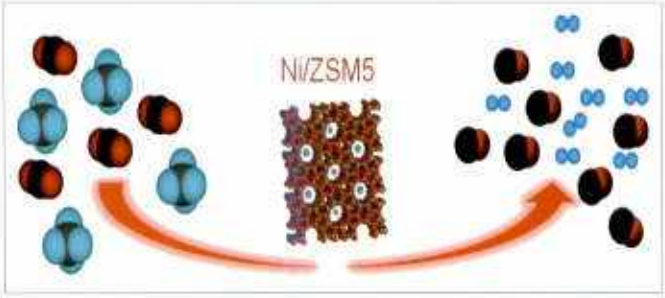
- **Selective Oxidation of Benzene to Phenol with Molecular Oxygen over Cu-Cr-oxide Catalysts**

Phenol is one of the most important chemicals in the industries, where the world production exceeds 7.2 megatonnes per year. Industrially, phenol has been produced from benzene by the three-step cumene process, which is not only energy-consuming but also less efficient, showing very low phenol yield (~ 5 %, based on the amount of benzene initially used) and producing lots of by-products such as acetone and –methylstyrene. Direct phenol synthesis from benzene is an alternative way to overcome these problems. We have found that nano-crystalline CuCr catalysts show a benzene conversion of ~30% with ~98% phenol selectivity using air as an oxidant at 623K.

- **Selective Oxidation of Propylene to Propylene Oxide with Molecular Oxygen over Ag-W-oxide Catalysts**

Propylene oxide (PO) is a versatile chemical intermediate used in a wide range of industrial and commercial products including polyether polyols, propylene glycols and propylene glycol ethers. By volume, it is among the top 50 chemicals produced in the world with the annual production of about 5 million tonnes. Industrial production of propylene oxide is mainly from co-oxidation of propylene with other chemicals but these technologies create additional side products. The major conventional manufacturing methods of PO are the chlorohydrins process and the Halcon process. The chlorohydrin process is being phased out because of environmental pollution, while the latter has the by-product limitation. So, a new environmentally benign technology has to be developed for production of propylene oxide. We have found that Ag nano-particles (size below 5nm) supported on WO_3 nano-rod (rod diameter ~ 30-50 nm, length 1-3 mμ) catalysts shows a propylene conversion of ~16% with ~86% propylene oxide selectivity using molecular oxygen as an oxidant at 623K.

- **Dry Reforming of Methane over Ni-Nanoparticles Supported on Mesoporous ZSM-5**

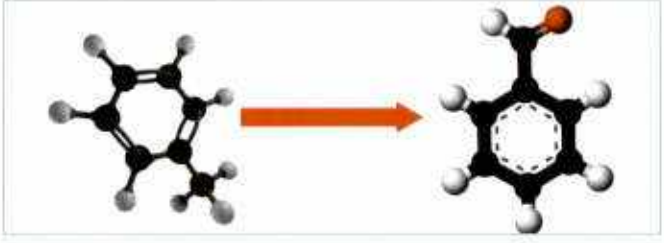


Pollution has become a major concern on a global scale and various factors consisting by-products in fossil fuels combustion, chemical combustion and synthetic fuel manufacturing etc. contribute to the emission of greenhouse gases into the atmosphere. The climate perturbation caused by the greenhouse gases (mainly methane and carbon-di-oxide), acid rain etc. have brought major fundamental issue to mankind. From this propagation, natural gas appears to be a clean and ecological source of energy and is now viewed as an area of competitiveness to improve the performance for the major oil companies. One of the processes that is commonly used in recent years is the dry reforming of methane. Indeed, this process is of particular interest because it uses two greenhouse gases via the reaction route ($CH_4 + CO_2 \rightarrow 2CO + 2H_2$). We have found that Ni-nano-particles supported on mesoporous ZSM-5 show very good activity and selectivity. A conversion of 92.8 % with ~ 100% CO selectivity (CO: H_2 molar ratio = 1:1) was achieved at 1073K.

- **Selective Oxidation of Cyclohexane to Cyclo-hexanone over Cu-nano-clusters Supported on Nano-crystalline Cr_2O_3**

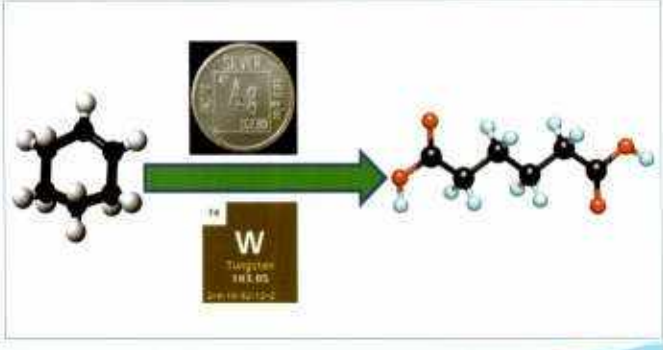
Cu-nano-clustures supported on nano-crystalline Cr_2O_3 was prepared by the hydrothermal synthesis method in the presence of the surfactant cetyltrimethylammonium bromide (CTAB) and it was found that the catalyst is highly active for selective oxidation of cyclohexane with H_2O_2 at room temperature. The cyclohexane conversion was 86% with cyclohexanone selectivity of 85% and overall C_6 selectivity (cyclohexanol & cyclohexanone) of 100% was achieved after 3 h of reaction at room temperature, over 4.3 wt% Cu-loaded on nano-crystalline Cr_2O_3.

- **Selective Oxidation of Toluene to Benzaldehyde**



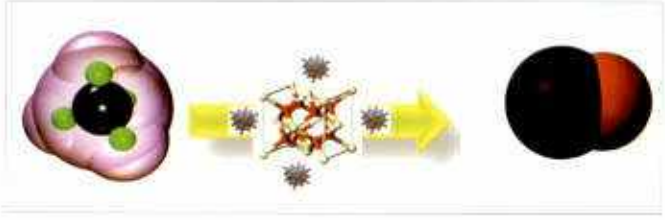
$CuCr_2O_4$ spinel nano-particles with the size between 20-40 nm was prepared by a hydro-thermal synthesis method in the presence of the surfactant, cetyltrimethylammonium bromide (CTAB). It was found that the catalyst is highly active for selective oxidation of toluene with H_2O_2 at 75° C. The toluene conversion of 57.5 % with 84.4% selectivity towards benzaldehyde was observed after 10 hours over $CuCr_2O_4$ spinel nano-particles catalyst.

- **Selective Oxidation of Cyclohexane to Adipic Acid**



We have developed a new synthesis strategy to prepare ~5 nm metallic silver nano-particles (AgNPs) supported on tungsten oxide (WO_3) nano-rod with a diameter between 40-60 nm, in the presence of cationic surfactant (cetyltrimethylammonium bromide : CTAB). A cyclohexene conversion of >99.9% with an adipic acid selectivity of 94% was achieved over ~5 nm AgNPs supported on WO_3 nano-rod catalyst with a very high turnover frequency of ~12 h^{-1}.

- **Partial Oxidation of Methane to Synthesis Gas**



We have developed a nano-size Ni-Ce oxide catalyst and a process for activation of methane to produce synthesis gas (a mixture of CO and H_2). The process provides a single-step selective vapour-phase partial oxidation of methane over nano-size Ni-Ce oxide catalyst to synthesis gas between the temperature range of 450 °C to 800 °C at atmospheric pressure over Ni-CeO_2 solid catalyst. The process provides a methane conversion of 20 – 97% with H_2 to CO molar ratio of 1.6 to 2 without deactivation till 100 h.

- **Coupling of Methane to Olefins over Nano-structured Catalysts**

The utilization of natural gas to produce petro-chemical derivatives has become an important research field as a result of oil depletion. One of the most abundant components in natural gas is methane. However, a large portion of methane is presently flared, due to the lack of conventional method to convert it into beneficial products. Since gases emitted from CH_4 flaring are believed to contribute significantly to global warming and are under discussion for further restrictions, its conversion into valuable added products is most likely be an industrial key step in the future. Currently, conversion of methane usually involves several steps, in which at least one of them requires high temperature and often elevated pressure, that make the overall reaction highly energy consuming and expensive. Thus the development of reaction pathways that convert CH_4 directly and selectively to added value products under mild conditions are greatly desired. Of many routes, the coupling of methane (oxidative or non-oxidative) is still one of the most promising choices for direct methane conversion. Here, we are focussing to develop nano-structured catalysts for conversion of methane to lower olefins.

So far, we got ~ 43% methane conversion with ~55% C_2 selectivity.

- **Alkylation Reactions over Nano-structured Solid acid Catalysts**

The most efficient chemical conversion industry, an oil refinery, loses small % and big real-volume hydrocarbons as off gases due to the larger scale of operations. Particularly, FCCUs contains lower olefins and paraffins which go as flare gases resulting in increased hydrocarbon losses and CO_2 emissions. The processing required to use them as pure valuable components is expensive and difficult. But to improve the profitability of the industry, reduce atmospheric emissions and green house gases, it is required to invariably recover these hydrocarbons by chemical conversion to useful liquid products as gasoline blendable molecules like liquid paraffin and ethanol.

Even though ethane and n-alkanes are less reactive, alkylation using olefins, mainly ethylene and alkanes or mainly ethane in off gases recovers maximum hydrocarbons in off gases after removing LPG and C_4 and above olefins. In the other option, reacting FCC off gases contents before recovering these valuable components is mainly researched in the industry. Ethylene and other lower olefins can also be converted to ethanol and recovered as liquid products without considering alkanes in gases.

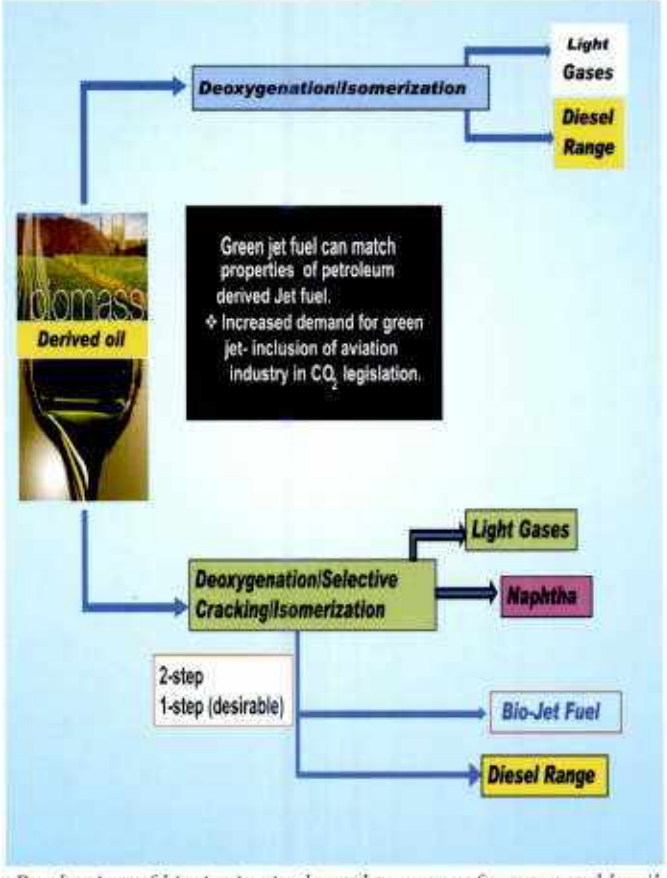
Here, we focussed on developing nano-structured solid acid catalyst for alkylation using lower alkenes.

1.1.8 हाइड्रोप्रक्रमण/Hydroprocessing

The thrust is on commercialization of technologies by exploring innovative ways for production of energy-efficient and sustainable fuels through renewable as well as non-renewable sources so that it helps build the energy security of our country, in terms of transportation and indigenously prepared chemicals.

- **Conversion of *Jatropha***

A process and a catalyst for conversion of *Jatropha* directly to aviation fuel (drop-in) was developed. Drop-in fuels are those fuels which do not require any changes, and hence can be used as such or as a blend with refinery-based fuels.



Production of bio-jet in single and two steps from vegetable oil

Our innovation is a novel single-step catalytic process for conversion of plant derived non-edible, waste, low-cost oils to produce drop-in bio-fuel for air-transport purposes. Plant-derived oils (soya, *Jatropha, Karanj,* algal) are deoxygenated, selectively cracked and isomerized over a single catalyst to produce aviation fuel with 35-55% yield and with properties and compositions exactly same as those required for aviation fuel. It is a unique single-step process to produce aviation fuel from renewable sources.

Technology / Process / Product development:

Sl. No	Title	Year of Development
1.	Technology Information Package for Revamp Of Existing Naphtha Hydrotreater To Process Non - Edible Oil For Renewable Aviation Fuel Production at BPCL Kochi refinery. By Products: Renewable Naphtha and renewable Diesel	2013-2014 2014-2015 (update and final submission)
2.	Stand-alone process for production of Renewable bio aviation fuels and renewable diesel	2014-2015 (further evaluations necessary for optimized coditions)
3.	Modular Microchannel reactor units	2014-2015 (still needs to be improved further)

- **Bio-jet production**

The main ongoing project has great societal as well as environmental impact. Production of fuel specially targeting aviation fuel from renewable sources is of great national importance. We at our lab have successfully achieved this milestone and the fuel produced is better in quality compared to whatever is available in the commercial market. Moreover this would take our nation among those few nations who have developed aviation fuel from renewable sources with a completely indigenously developed technology. Development of such renewable source-based fuel would have great impact in terms of carbon credits, environment-friendliness and sustainability. We are also in talks for commercialization of the process developed for vegetable oil processing into aviation fuel with many companies such as RIL, BPCL etc.

A proposal to OIDB was submitted for revamping a facility at BPCL-KR into Bio-aviation fuel production facility. We have successfully scaled up the process for the production of renewable fuels from lab scale to industrial scale and submitted a Technology Information Package to BPCL-KR for revamping their HGU-PDS unit into processing non- edible oils.

We also successfully completed the project for organizing a workshop under "Australia-India Strategic Research

Fund" entitled *"Biofuel- A key to future green and sustainable aviation"*. Participants from various institutes and industries in Australia (UOM, CSIRO, RMIT, Virgin Australia) and India (CSIR, IIT-R, Air-India, DGCA, RIL, BPCL, HPCL, CEMILAC, DRDO, ENVISA, Punjab Agricultural University) participated and discussed on bio-jet fuel production technologies being developed globally, but in particular in India and Australia. Participants through expert's presentations interrogate the potential of using waste farm land to grow high oil yielding crops, the conversion of agricultural and other farm wastes to bio-fuels and other feed stock sources considering the social, environmental and economic criteria, without impacting on food security. The participants also declared and pledged the production, usage and demonstration of renewable aviation fuel.

This laid a major impact upon and awareness among statutory authorities, airlines and fuel manufacturers regarding the importance of bio-Jet fuel in the Indian aviation fuel market.

Activites:

- Bulk production of the bio-jet fuel on existing pilot-plant (continuous pilot plant run) is going on smoothly for engine testing. Approximately 3000 litres of *Jatropha* were processed and 600 litres of bio-jet were formed
- Models developed to know the product pattern and conditions were optimized
- New experiments carried out on different catalyst bed arrangements, lower hydrogen/feed ratio, WHSV and pressure variations on Pilot plant
- 150 litres of bio-jet had already been supplied to M/s Pratt and Whitney, Canada for engine tests; 65 litres of bio-jet had been already sent to the IOCL for further testing.
- A large-scale pilot plant was currently in operation where almost 15 litres of jet per day could be produced
- 120 litres of bio-jet sent for testing at IIT-Kanpur
- Plant was running in continuous mode for life analysis and it had already completed its successful six months.
- SOR, EOR strategy, catalyst life testing, large-scale pre-treatment strategy completed
- Project completed for the revamp of existing naptha hydrotreater at BPCL-Kochi refinery, for a demo plant of the capacity of 4.6 tonnes/hr of vegetable oil feed processing

Some Salient Achievements:

- Development of Rubber Extender Oil (REO) from CSO of Reliance
- Technology Information Package for Revamp of Existing Naphtha Hydrotreater To Process Non-Edible Oil For Renewable Aviation Fuel Production
- Pilot plant run for Hydrogenolysis of glycerol to 1,2-propanediol (part1 and part2)
- Application of bio-fuels for aviation: Green jet fuel from *Jatropha* oil (Bio-jet)
- Production of second- and third-generation bio-fuels (biomass-to-liquid)
- Hydrogenation activity of Pd/C catalyst
- Workshop on *"Biofuel- A key to future green and sustainable aviation"*
- Submitted Projects to DRDO, entitled *"Development of Catalytic Process for Production of Isoprene from pure isopentane and isopentane containing refinery C_5 streams"*.
- Installation and commissioning of three new equipments A) *In situ*-FTIR Reactor setup, B) 2-Dimensional GC*GC-Mass-FID setup, C) Particle Size Analyzer setup and setting up of procedures

1.1.9 तरल उत्प्रेरकीय भंजन/Fluid Catalytic Cracking (FCC)

- **Evaluation of HPCL (V) Fresh Fluid Catalytic Cracking Catalysts**
- **Co-processing of hydrodeoxygenated fast pyrolysis oil with VGO in FCC unit**

In the present study, the *Jatropha*-derived heavy or tar fraction of fast pyrolysis oil (FPO) with vacuum gas oil (VGO) and hydrodeoxygenated fast pyrolysis oil (HDO) with VGO was co-processed in a standard refinery fluid catalytic cracking (FCC) unit. The crude fast pyrolysis oil from *Jatropha curcas* is produced at 530°C and atmospheric pressure using a bubbling fluidized bed pyrolyzer. The heavy fraction of FPO is hydrodeoxygenated over Pd/Al_2O_3 catalyst into HDO in an autoclave reactor at 300°C and pressure of 80 bar. Further, HDO is coprocessed with petroleum-derived

VGO in an advanced cracking evaluation (ACE-R) unit to convert it into refinery FCC products or slate hydrocarbons at a blending ratio of 5: 95. FPO and HDO are characterized using ^{31}P NMR, whereas FCC distillates, which are obtained on the co-processing of VGO with fast pyrolysis oil and HDO, are characterized using ^{1}H and ^{13}C NMR spectroscopy techniques. The ^{31}P NMR analysis of crude FPO and HDO indicated that hydroxyl, carboxylic and methoxy groups are reduced during the hydrodeoxygenation of FPO. The experimental results at the iso-conversion level on the co-processing of HDO with VGO indicated a higher yield of liquefied petroleum gases (LPG), while lower yields of gasoline and LCO have been observed as compared to FPO co-processing with VGO and co-processing of pure VGO. Furthermore, the results of co-processing of FPO with VGO indicated that the yields of gasoline and LCO increased from 29 to 35 wt% and 14.8 to 20.4 wt%, respectively, whereas the yields of dry gas and LPG decreased from 2.1 to 1.4 wt% and 38.8 to 23.7 wt.%, respectively, for an increase in the blending ratio from 5% to 20%. Therefore, it can be concluded that the co-processing of HDO with VGO in a FCC unit would be feasible in order to achieve a higher yield of LPG.

- **Development of HY Zeolite from coal-derived fly ash for catalytic cracking of VGO**

1.1.10 हल्का स्टॉक प्रक्रमण एवं उत्प्रेरकीय पुनःसंभावन / Lightstock Processing and Catalytic Reforming

- **Synthesis of Orderly Nano-porous Alumino-phosphate and Zirconium Phosphate Materials and their Catalytic Applications**

A simple and novel method for the synthesis of ordered nano-porous aluminophosphate and zirconiumphosphate materials possessing promising catalytic activity towards industrially important selective alkylation of phenol for the efficient production of C-alkylation and O-alkylation products was developed. Further, the materials show their reusability with an excellent catalytic performance even after five reaction cycles. The subject opens up a new property of the nano-porous aluminophosphate and zirconiumphosphate materials as suitable catalysts for selective alkylation reactions and has scope for improvement of the catalytic activity through optimization of the synthesis procedure of nano-porous aluminophosphate and zirconiumphosphate for expanding their applications to other selective alkylation reactions.

- **Selective Production of Green Gasoline by Catalytic Conversion of *Jatropha* Oil**

A catalytic process for value addition of bio-oil derived from the *Jatropha curcas* plant through the production of green gasoline has been described. Four zeolite-based catalysts possessing different porosities and acidities have been prepared by using Ultrastable Y (HY), Beta (BEA), micro-crystalline ZSM-5 (MZ) and nano-crystalline ZSM-5(NZ) zeolites. The textural properties of the samples have been characterized by XRD, SEM, BET surface area, pore volume, pore size distribution and micro-calorimetric ammonia adsorption studies. These catalysts have been exploited for production of the green fuel suitable for gasoline applications. Among various catalysts, the nano-crystalline ZSM-5 synthesized in the laboratory exhibited excellent catalytic properties such as moderate acidity and stacking order of mesoporosity (which is absent in microcrystalline ZSM-5) responsible for production of gasoline with as high as 77.4% selectivity and 95 research octane number (RON). The catalyst also exhibited enhanced time-on-stream stability supported by coke resistance ability (derived from TGA analysis of spent catalyst) when compared with the other zeolites within the studied period of 20 h. The present study provides a new catalytic process for production of gasoline from *J. curcas* oil for bio-refinery.

- **Break-through Mesopore Creation in BEA and its Enhanced Catalytic Performance in Solvent-free Liquid Phase Tert-butylation of Phenol**

A thermally stable, highly mesoporous BEA zeolite (DSB) exhibiting a more-than-two-fold increase in pore volume was obtained by applying a desilication process followed by an ammonium nitrate treatment on the BEA (SAR = 25), and a breakthrough increase formation of mesopores contributing to 93% of total pore volume was achieved without any structural damage to the zeolite framework. Such an effective desilication process observed in the present study may be ascribed to the presence of a relatively high aluminium content in the framework of the parent BEA (SAR = 25). This is also reflected in the overall improvement in the acidity of the sample in terms of strong acid sites. With the combination of mesopores and the strong acidity, the resulting DSB exhibited excellent catalytic activity in the tert-butylation of phenol with improved conversion and selectivity towards the bulky product, 2,4-di-TBP, which is an important intermediate for fine chemical and

polymer industries. Furthermore, the highly mesoporous material obtained in the present study is expected to be an excellent catalyst for various other industrially important bulky molecule-involved reactions.

- **Enhanced Production of High-Octane Gasoline Blending Stock from Methanol with Improved Catalyst Life on Nano-crystalline ZSM-5 catalyst**

Methanol value-addition reaction has been studied on lab-synthesized nano-crystalline ZSM-5, Si/Al = 13 (NZ) possessing particle size of ~29–51 nm and a micro-crystalline ZSM-5 (MZ) of similar atomic ratio is also taken as standard for comparison studies. The NZ sample exhibited excellent catalytic activity to produce 50.7 wt.% of high-octane (Research Octane Number = 137) gasoline blending stock rich in desired toluene and xylene components, while the undesired benzene is very low, suitable for fuel applications. The superior performance of NZ to MZ catalyst reflected in the three-fold increase in gasoline yield and considerably high time-on-stream performance.

- **Synthesis of Carbon-embedded MFe_2O_4 (M = Ni, Zn and Co) Nano-particles as Efficient Hydrogenation Catalysts**

Highly crystalline, uniform-size spinel of MFe_2O_4 nano-particles@C was obtained in the present study through the sol–gel hydro-thermal synthesis method followed by carbonization, adopting a novel approach of establishing an interaction between the carbon source and metal ions in the monomer level itself. The levulinic acid possessing both carboxyl and carbonyl functional groups and used in the present study might be responsible for facilitating interaction with the carbon source on the one hand and the metal ions on the other hand so as to form the carbon-embedded metal nano-particles. Further, the–COOH group in levulinic acid might be responsible for the stabilization of the $NiFe_2O_4$ unit against agglomeration during polymerization /carbonization reactions of phloroglucinol. The $NiFe_2O_4$@C catalyst exhibiting well dispersed small size nano-particles of ~10 to 20 nm obtained in the present study provides a scope for synthesis of other metal nano-particle supported catalytic systems by adopting this novel approach of using bi-functional levulinic acid as a binding molecule for establishing strong metal–support interaction. Excellent activity in selective hydrogenation of styrene to ethyl benzene exhibited by the present catalyst system envisions its scope for industrial applications through hydrogenation of various non-aromatic double bonds involved in chemical systems related to fine chemicals and drug delivery.

- **Facile Synthesis of Mesoporous Aluminosilicate Nano Particles for Selective Production of N-Benzylidenaniline in Solvent-Free Reaction of Aniline with Benzyl Alcohol**

- The studies provide a simple solvent-free physical mixing method using a low-cost template for synthesis of mesoporous aluminosilicate nano-particles. The study provides a physical mixing method as an efficient tool for production of heteroatom containing silica nano-particles which can be further expanded for synthesis of other mixed oxide nano-particles. The materials possessed excellent catalytic properties towards the N-alkylation reaction, where a selectivity as high as 100% towards N-benzylidenaniline (imine) was obtained from aniline and benzyl alcohol under environmentally benign, solvent-free, low severity reaction conditions. Here, the solvent-free conditions adopted both in synthesis of the materials and in their catalytic application makes the process simple, economic, user-friendly and environment-friendly. This study is the first of its kind to observe the selective production of imines (100%) on alumino-silicate materials that reports the novel properties of the materials. The selective imine formation ability of the materials can be exploited for other industrially important N-alkylation reactions to improve the selectivity towards the desired product.

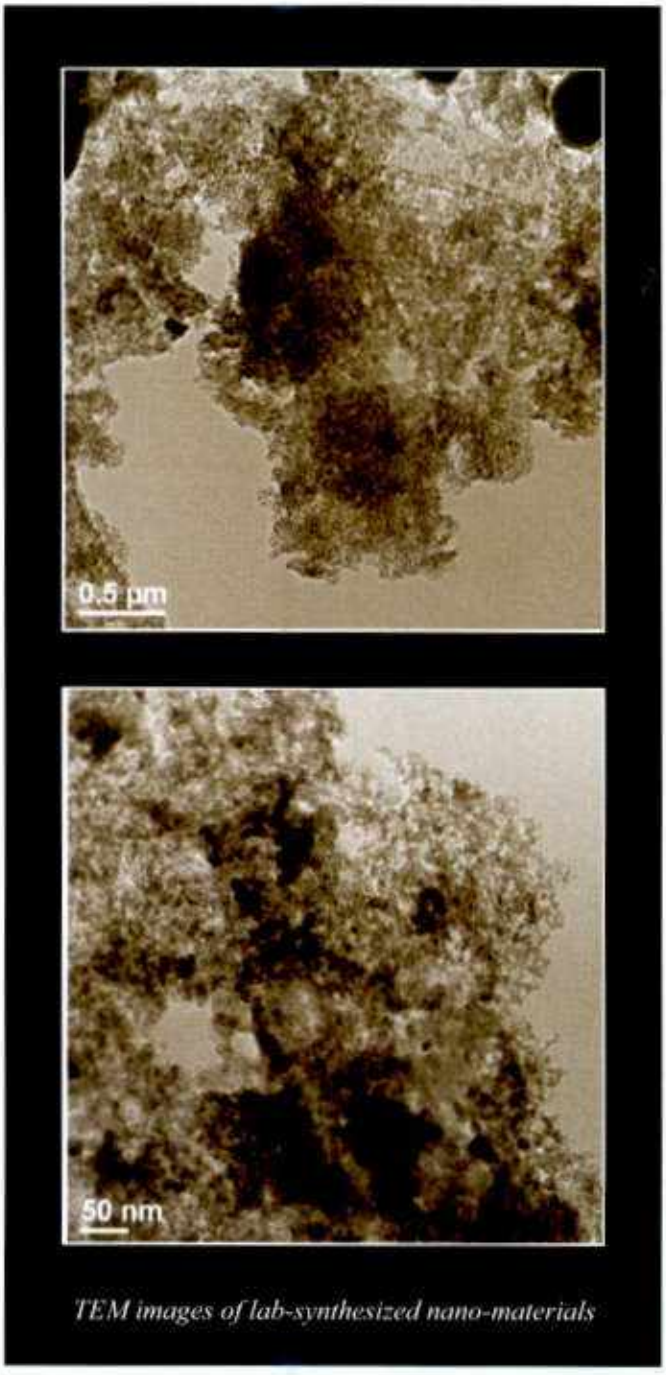
- **Functionalized Hierarchical Nano-composite Materials for Synthetic and Renewable Fuel Production**

- Carbon-silica composite materials exhibiting high-quality morphology and chemical properties were successfully synthesized using glucose as templating agent by adopting hydrothermal and calcination methods.

- The functionalized SCS materials synthesized at IIP exhibited superior properties in terms of nano-particle size (20-30nm), mesopore generation and acid bearing capacity that collectively suggest the suitability of the materials for acid catalyzed reaction application.

- Functionalization of carbon-silica composite with metals have been tried

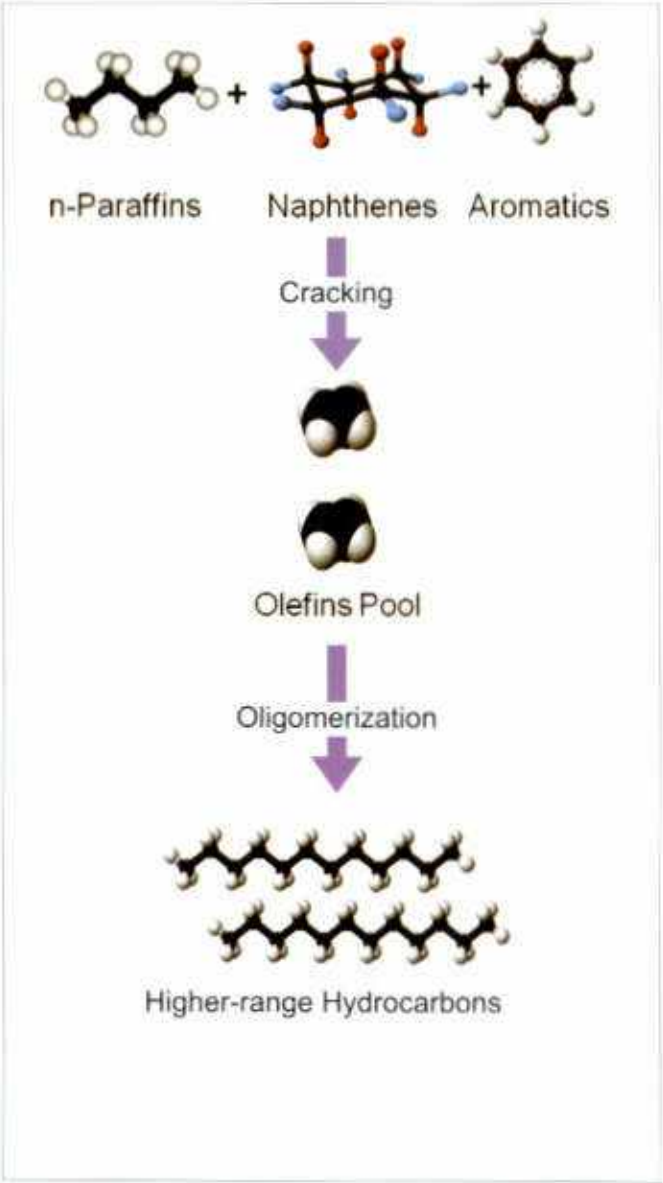
- The materials synthesized were applied for conversion of *Jatropha* oil at CSIR-IIP.
- The good quality nano-size hierarchical mesoporous material obtained at CSIR-IIP was functionalized with metal and gave promising activity in bio-oil processing.
- Further, the catalyst samples were submitted to CSIRO to explore their suitability towards FT reaction



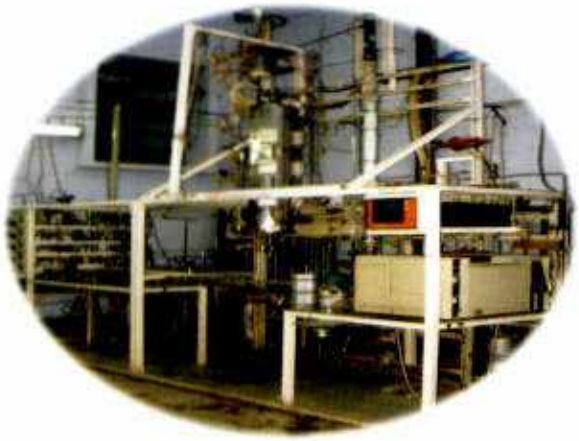
TEM images of lab-synthesized nano-materials

- **Development of Novel Multifunctional Solid Acid Catalyst for Conversion of Naphtha**

Production of higher-range hydrocarbons from low-value naphtha is the novelty of this research. The approach was through cracking-based olefin formation and oligomerization for production of higher range hydrocarbons.

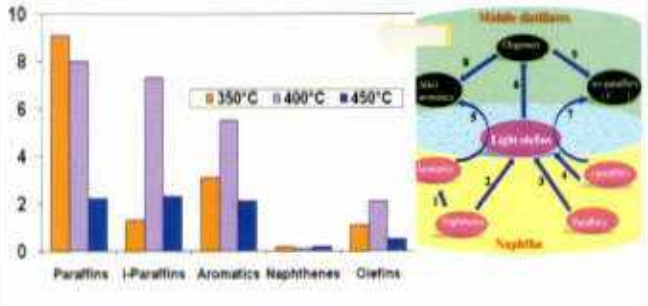


This is a single-catalyst, single-step process developed for the first time.



Pilot Plant Used in the naphtha conversion process

Extrudates of the Catalyst prepared at the CSIR-IIP



Catalyst performance for middle distillate production

Salient Features :

- Solid acid catalysis provides a tool for reconstruction of the hydrocarbon molecules for their value-addition
- Cracking-based oligomerization is a novel concept for increasing the hydrocarbon chain length
- The olefinic pool obtained in the reaction acts as an intermediate for production of a variety of molecules
- Preliminary studies give up to 23 wt% yield of the heavy hydrocarbons
- Single-step catalytic conversion of naphtha to middle distillates was realized for the first time and it has a wide scope in catalyst development

- **Synthesis of efficient catalyst materials from the cheaper and renewable sources**

Salient features :

- The hierarchical ZSM-5 zeolite samples have been synthesized by using the low-cost template precursor glucose
- The total pore volume as well as mesopore volume is increased in the higher glucose-based synthesized samples. This has resulted in the overall increase in the average pore diameter of the samples with glucose concentration. The BJH adsorption average pore diameters of the corresponding samples are 2.3, 6.7 and 7.2 nm which further suggest that increase of glucose concentration leads to the shift of the mean pore diameter to higher value
- All the three hierarchical mesoporous ZSM-5 samples exhibited higher conversions (34 - 46%) when compared to the mere microporous ZSM-5 zeolite
- The material (MZ0.64) exhibited higher conversion (44%) and relatively higher 4-TBP selectivity (81%). This sample also produced highest di-alkylated product (2,4-DTBP)
- The synthesis method provides an economical path for production of hierarchical aluminosilcates with tailored mesoporosity (controlled by glucose) for various industrial applications and could be extended for the synthesis of other types of zeolites
- The materials possessing well-connected network of micro-/ meso-/ macropores can be the sources for the variety of bulky molecular reactions and better replacement for conventional ZSM-5

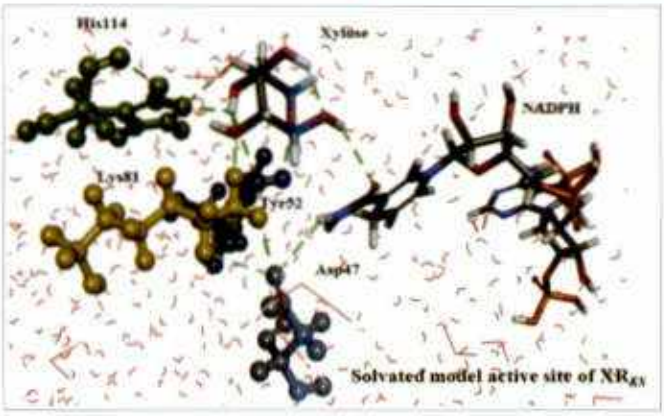


Figure 2: Predicted solvated model of thermo-tolerant yeast xylose reductase

Sl. No.	Protein name	Features	Score/ Value	Remarks
1.	Xylose reductase from *Kluyveromyces* sp. IIPE453	Aggregation score	69.586	+ve score indicates no aggregation
2.		Molecular weight	37 KDa	Monomeric unit
3.		GRAVY score	-0.234	High water solubility
4.		pI (Isoelectric point)	5.39	——
5.		Molecular charge	1.59	Charged protein

Table 1: XR characterization

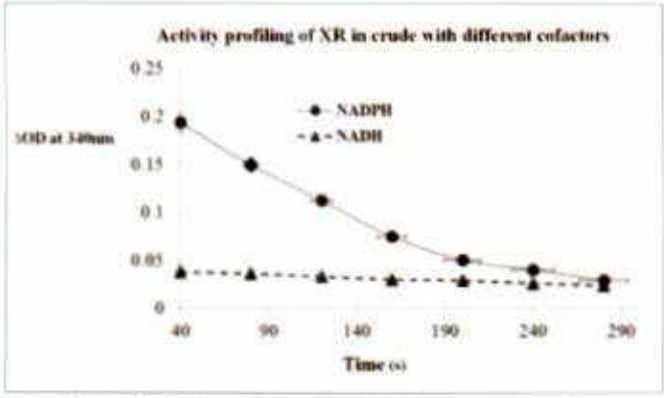
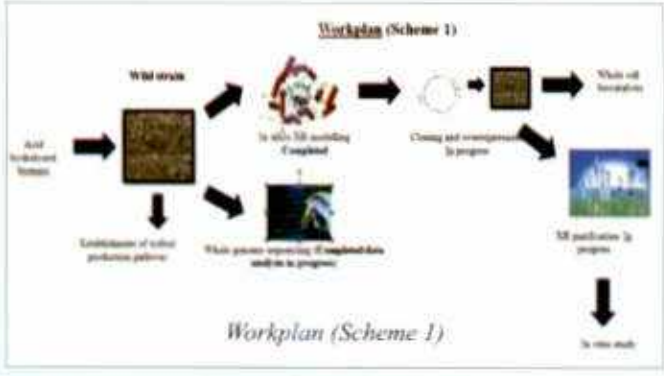


Figure 3: Reductant requirement of XR; XR specificity for NADPH over NADH



Workplan (Scheme 1)

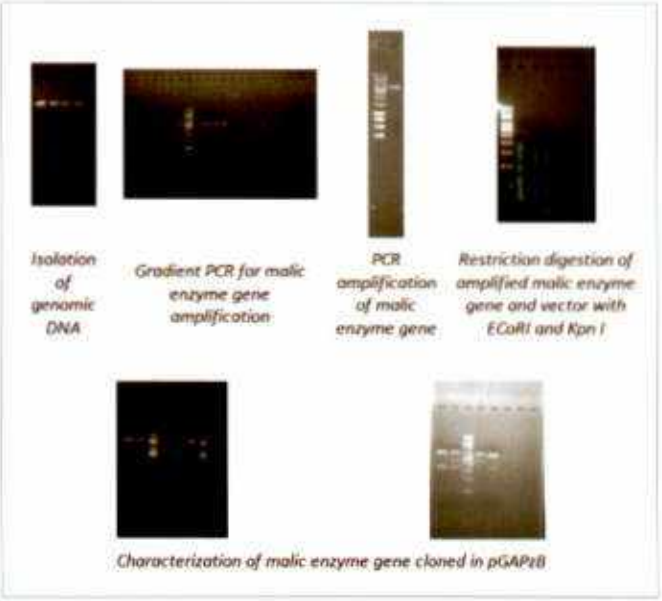
- **Genetic Modification of Oleaginous Yeast for Enhanced Bio-fuel Production**

Maximum lipid accumulation by oleaginous micro-organisms using cheap carbon sources like lignocellulosic bio-mass-derived fermentable sugars and further recovery of single cell oil are major challenges for successful commercial use of microbial lipids as feedstock for bio-fuel. Lipid accumulation in oleaginous micro-organisms takes place under nutrient limiting conditions usually nitrogen-limiting conditions. The total lipid produced depends on both the lipid accumulated per cell and the overall cell titre. The nitrogen limiting conditions are also a bottleneck for maximum lipid accumulation as too low nitrogen also affects the overall cell growth. Therefore, genetic modification of oleaginous yeast to enhance bio-fuel production is the main objective of this work in order to overcome this limitation.

- **Genetic Modification of an Oleaginous Micro-organism to Enhance Bio-fuel Production**

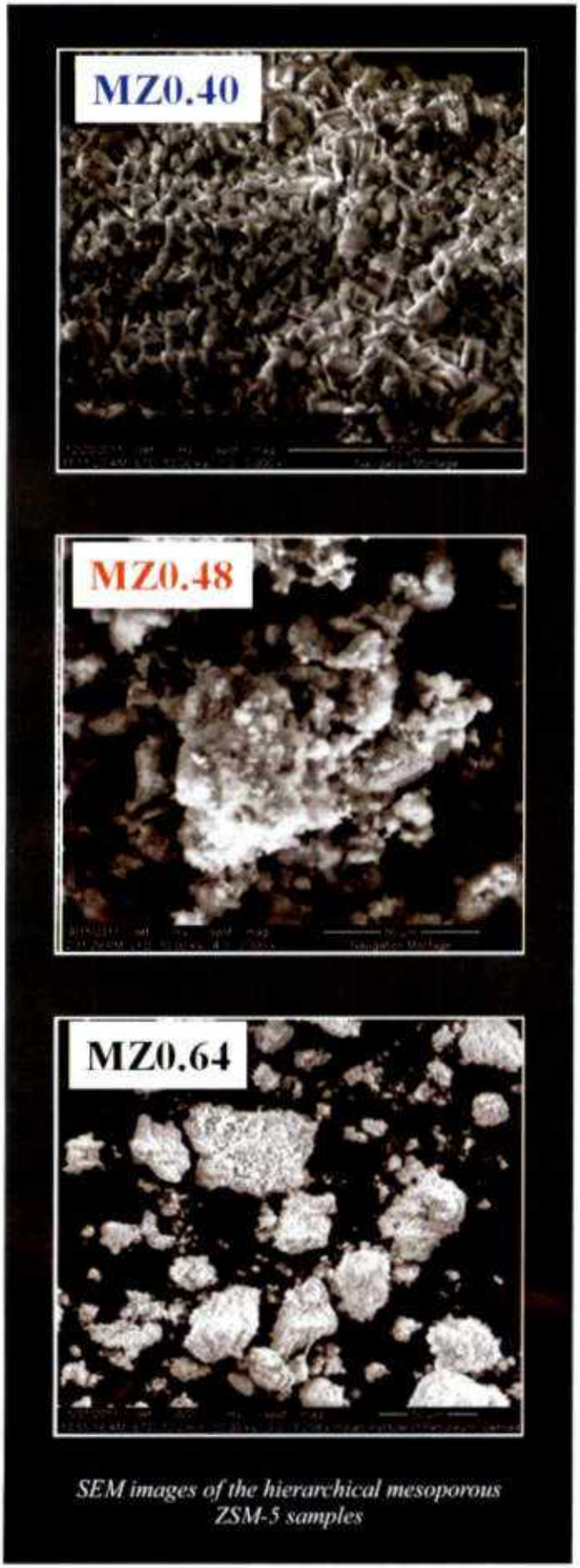
The following methods were applied:

1. Isolation of the malic enzyme gene from oleaginous yeast, *Rhodotorula glutinis*.
2. Cloning into expression vector
3. Transformation into the in-house oleaginous yeast



Characterization of malic enzyme gene cloned in pGAPzB

Transformation in TOP10 for stable maintenance of cloned gene: After ligation of malic enzyme gene with vector, transformation by Calcium Chloride method was carried out. The cells were plated on medium containing 50ug/ml Zeocin. Only cells transformed with vector were able to grow.



SEM images of the hierarchical mesoporous ZSM-5 samples

1.2 जैव–ईंधन / Bio-fuels

1.2.1 जैव–प्रौद्योगिकी रूपांतरण/Bio-technology Conversion

Xylitol, a pentanol, is widely used as a sweetener in human consumption. It is produced via catalytic hydrogenation of xylose at high temperature and pressure. The major process drawback is the formation of multiple side products due to severity which makes xylitol downstreaming extremely difficult and energy-intensive.

We are seeking feasibility of xylitol production from xylose via microbial route alternative to the existing process. A thermo tolerant yeast has been identified as a potent xylitol producer from the C_5 sugar. However, the yield is extremely low and requires selective strain tinkering to improve the titre. A whole genome sequencing of the strain was carried out to know the xylitol production pathway (Figure 1) and the genes associated with the production of the same. The enzyme which is the sole factor in guiding the bioconversion has been deeply looked into both at genetic and protein levels. The enzyme has been partially purified and characterized both *in silico* (Figure 2; Table 1) and experimentally in terms of its pH stability, thermostability, PI and reductant requirement (NADPH) (Figure 3). A strategy for over-expression of the gene encoding the enzyme is in progress for improving xylitol productivity (Scheme 1).

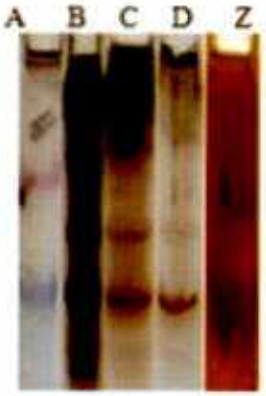
Figure 1: Whole genome sequencing reveals genes associated with xylitol production pathway in thermo tolerant yeast

Characterization of gene: Plasmid was isolated from 5 transformed clones selected from the Zeocin-containing plates and were characterized whether they contain the correct insert. Based on *in silico* analysis, XbaI should give one band of 6.2 kb, and BglII two bands: one of 2245 bps and the other of 3947 bps. Out of five, one gave positive result.

Malic enzyme purification : Malic Enzyme has been suggested to play a vital role in regulating the extent of lipid accumulation in oleaginous yeasts by direct channelling of NADPH to fatty acid synthase (Wynn et al., 1999). Based on literature, it appears to be a very important enzyme affecting lipid accumulation in oleaginous yeast, and was therefore chosen for study. Since we are aiming to over-express malic enzyme, it is important to first gain an understanding of the enzyme itself. For this, we carried out the purification of malic enzyme. Growth of cells was carried out in Air lift fermentor in the OP 24 glucose medium. The growth was carried out in two phases, a growth phase of 5 hours, and a maturation phase of 3 hours. Cell disruption was carried out in a homogenizer at 900-1000 bars and cell suspension recycled for 60 minutes maintaining the temperature at 4°C.

Partial purification table

Purification step	Specific Activity (U/mg)	Purification fold	% Recovery
Crude extraction	0.09	1	100
Cation exchanger	0.14	1.55	27.53
100 kD membrane filtration	0.28	3.14	25.97

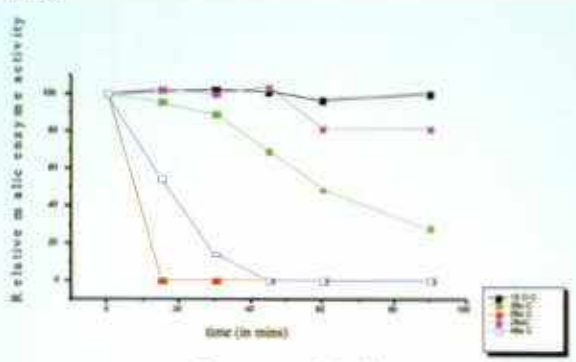


A: Ladder
B: Crude
C: Cation exchanger
D: 100 KD retentate
Z: Zymogram

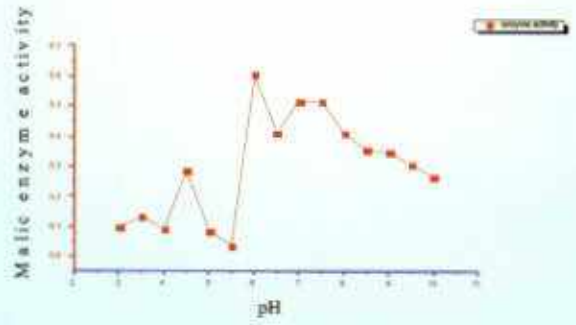
Enzyme Characterization

Temperature Profile: The enzyme was incubated at different temperatures ranging from 15°C to 55° C. The enzyme activity was evaluated at different time intervals. Activities have been represented as the percentage of residual activity compared to native enzyme activity. The enzyme was most stable at 15°C.

pH profile: Enzyme activity was checked at different pH levels of buffer. Three pH optima were observed at 4.5, 6 and 7.5.

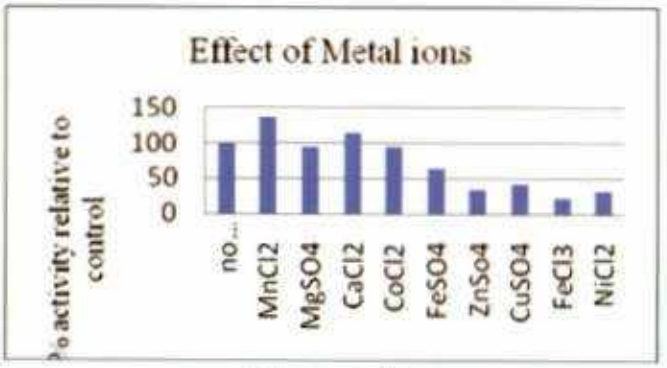


Temperature Profile

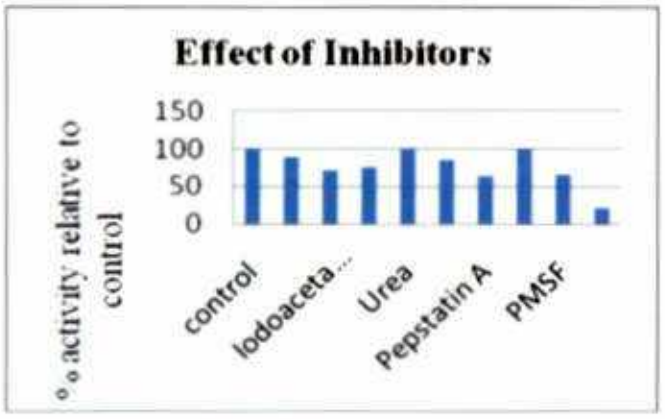


pH Profile

Activator Studies: Activities were calculated relative to a control without any metal ions. $MnCl_2$ and $CaCl_2$ enhanced malic enzyme activity, while $FeCl_3$ and $NiCl_2$ showed maximum inhibition of malic enzyme.



Activator studies



Effect of protein inhibitors

Effect of protein inhibitors: Effect of protein inhibitors on malic enzyme activity was evaluated at a final concentration of 1mM, incubated at 25°C for 15 minutes. A control without any inhibitor was considered as 100%. Activities were calculated relative to this control. Maximum inhibition was obtained with 4-chloromercurobenzoic acid.

- **Bio-Prospecting Anti-microbial Peptides (AMP) from the Uttarakhand Himalayas**

Micro-biologically influenced corrosion (MIC) is a type of metal deterioration due to metabolic activity of various micro-organisms. Bacteria in petroleum industry are a well known problem because organic fuels provide an ideal environment for bacteria to feed and grow. To combat this problem, anti-microbial peptides are being targetted. Anti-microbial peptides (also called host defense peptides) are part of the innate immune response and are found among all classes of life. Anti-microbial peptides have been demonstrated to kill Gram-negative and Gram-positive bacteria, enveloped viruses, fungi and even transformed or cancerous cells.

The project aims to screen an anti-microbial compound which helps in reduction of the bio-film and characterization of the same. In this regard, following objectives have been addressed.

Objectives:

- Screening of anti-microbial compound
- Scale-up of anti-microbial compound production
- Purification of anti-microbial compound
- Characterization of anti-microbial compound

➢ **Screening of anti-microbial compound from different soil samples**

Soil samples from different habitats like Doiwala, Lachhiwala etc.of Dehradun were collected. Various bacterial isolates were screened for anti-microbial properties. Isolate IIPAMB321 gave stable anti-microbial activity and thus, further analysis was done using this strain.

A 72-hour culture of the strain was used for extracting anti-microbial compound. Different organic solvents were screened to obtain maximum extraction of the compound from the supernatant of centrifuged culture. Extract obtained using chloroform gave maximum anti-microbial activity.

Bacterial culture

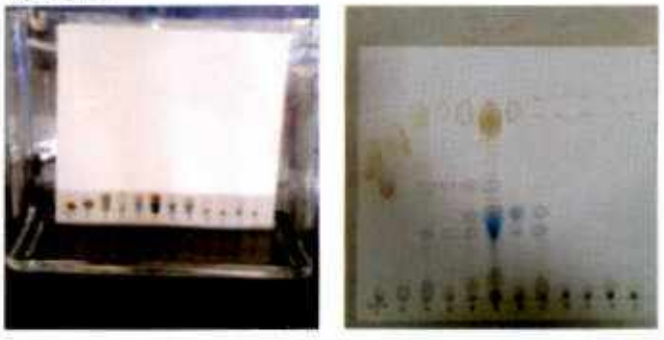
Zone of inhibition of crude sample against E. coli DH5

➢ **Scale-up of anti-microbial compound production**

IIPAMB321 was scaled up in NBS Bioflo110 5 L working volume in LB medium to extract anti-microbial compound for subsequent purification. It was optimized that 72 h batch produced the maximum active lead compound.

➢ **Purification of anti-microbial compound**

Silica (60-120 mesh) gel column prepared in ethyl acetate was used to purify the crude extract obtained from supernatant of centrifuged culture. Ethyl acetate along with increasing concentration of methanol was used to elute fractions from the column. The fractions obtained were concentrated using rotavapour, and anti-microbial assay of the same was done against *E. coli* DH5. Fraction VI gave maximum anti-microbial activity. Thin layer chromatography was used to monitor the purification of fractions.

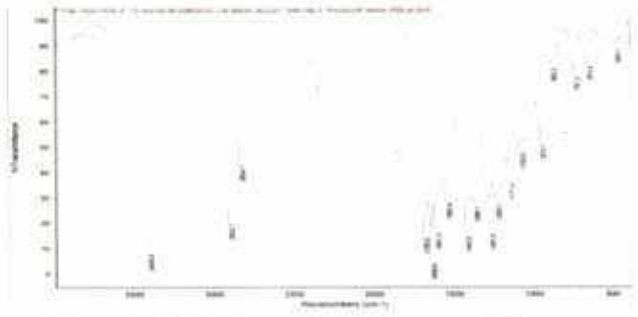


TLC Profile

➢ **Characterization of anti-microbial compound**

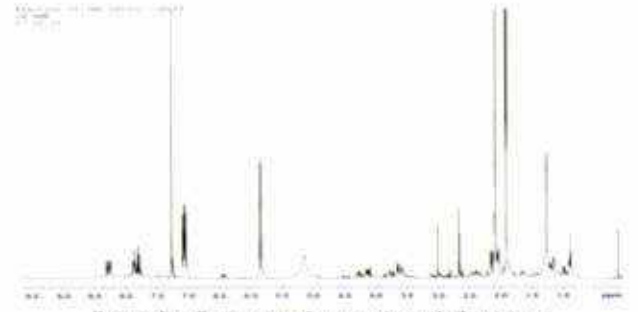
FTIR and NMR of the Fraction VI were done to understand the molecular structure of the compound.

FTIR Spectra



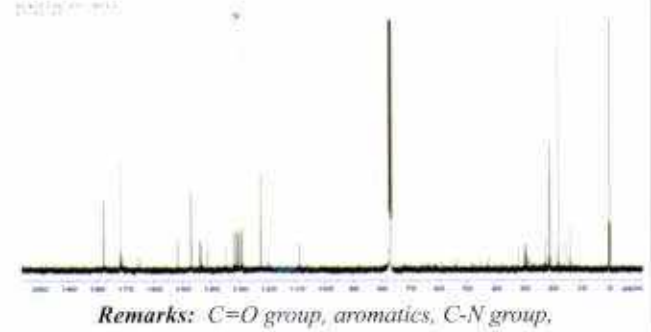
Remarks: *Aliphatic group, aromatic group, OH group, C=O group, -OH group are present*

H NMR



Remarks: *Presence of aromatics, olefins group, C-O group, aliphatic chain*

C NMR



Remarks: *C=O group, aromatics, C-N group, aliphatic chain may be present*

• **Protein-based Photovoltaics**

Herein, the development of a protein-based photovoltaic cell is aimed at by integrating the potentiality of bacterial photo-sensitive proteins miniature and highly efficient photovoltaic devices with the solid-state electronics; thereby offering an inexpensive, eco-friendly, highly efficient technology to the society.

Technical limitations of the existing products, processes and/or services

The key challenges associated presently with the protein-based photovoltaics include:

- Scalability
- Robustness
- Adaptability to different environmental conditions
- Retention of their spatial organization after immobilization onto the extremely electrically conductive materials

Attempts to circumvent these problems

- Isolation and characterization of preferentially thermophilic purple and green sulphur/non-sulphur bacteria from different hot-spots and their photo-sensitive protein.
- Screening of membrane proteins of selected bacterial species on photo-potentials and photo-current using multi-well current-sensitive device. Orientation of protein molecules for efficient electron transport through molecular modelling.
- Development of thin film-coated proteins on nano-semiconductors deposited by various methods such as Langmuir–Blodgett technique, poly-electrolyte self-assembling or electro-sedimentation.
- Development of prototype protein-based PVCs with protein composite materials.
- Final target is the development of protein-based photovoltaic cell with a minimum of 8% efficiency and 5000 hours stability.

• **Translation of Discoveries Into Lead Bio-molecules**

According to Auto Fuel Policy regulations in the country, growing concern over environmental effects caused by burning of fossil fuels and current processing technologies, sulphur level in transportation fuels–particularly in diesel–must be reduced by 90% or more below current level (500 ppm). So there is an urgent need of developing green technology to meet the desired level of concentration of sulphur in gasoline, diesel & fuel oils. Biological desulphurization (BDS) offers an attractive alternative to conventional technology (HDS) due to mild operation conditions without the use of H_2 resulting in energy saving, greater potential for removal of recalcitrant sulphur compounds, besides it being highly specific and environmentally friendly. Overall BDS

efficiency is limited by the specificity of current whole-cell bio-catalysts, end products inhibition and the slow rate of desulphurization of terminal enzyme, HPBS-desulphinase Dsz B. BDS will require enzyme systems, particularly Dsz B that are highly active and stable besides high selectivity of a wide variety of organo-sulphur compounds present in crude oil. More numbers of such a bio-catalyst could be achieved by combination of molecular biology, directed evolution, protein engineering, and could be applied for the development of efficient fuel processing technology for the petroleum industry.

Herein, engineering robust enzymes for selective bio-transformation/desulphurization is aimed at.

Research Gaps and Scope Of R&D

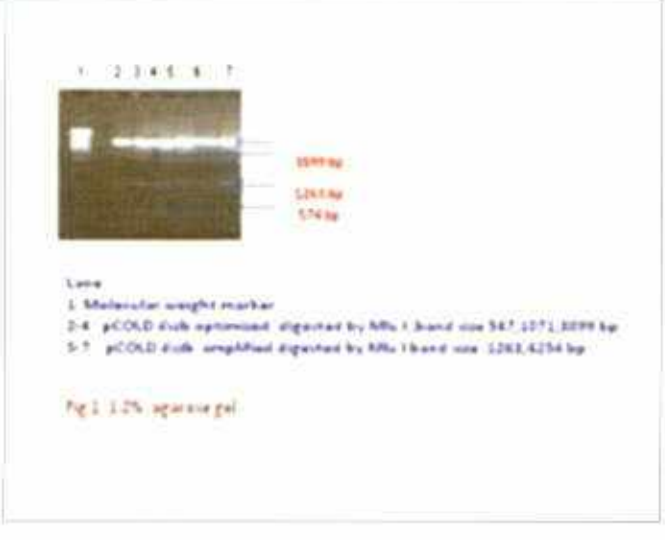
In order to develop a highly efficient BDS process it is required to understand the characteristics of less stable dszB which is a rate-limiting enzyme in 4S pathway besides further improvement through over-expression of limiting genes in pathway.

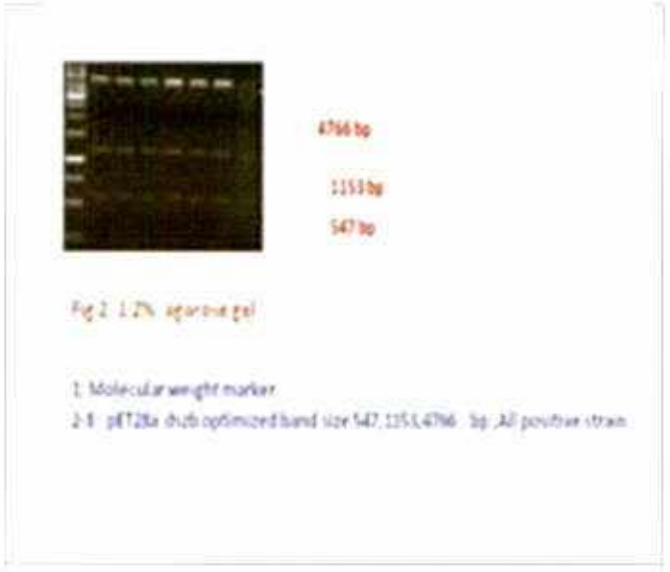
Approach

- Cloning of amplified gene in suitable vector and expression study.
- Development of shuttle vector and cloning of gene in shuttle vector.
- Shuttle vector transformation in host organism.
- Expression study in host organism.

Results:

Amplified gene in suitable vectors and expression study





1.2.2 ताप–उत्प्रेरकीय प्रक्रम/ Thermo-catalytic Processes

- Study of hydro-thermal upgradation of lignocellulosic and algal bio-mass
- Development of database for hydropyrolysis of several Indian agricultural and forest residues
- Slow pyrolysis of local agricultural, forest and defatted bio-mass
- Detailed physico-chemical characterisation of bio-oils
- First-ever studies carried out on the pyrolysis of e-waste in India

1.2.3 रासायनिक रूपांतरण/Chemical Conversion

- **Valorization of Glycerol for Bio-degradable Base Fluids and New Bio-fuel Formulations**

Glycerol is the inevitable by-product of the trans-esterification process. The recovery of high-quality glycerol as a bio-diesel by-product is the primary option to be considered for lowering the cost of bio-diesel. Glycerol cannot be added directly to fuel due to its decomposition, polymerization & consequential engine problems at high temperature. Therefore, serious R&D efforts are required to have a new generation of lubricants with increased thermal stability and mechanical stress ability along with lower consumption, ecological safety and rapid bio-degradability together with a new class of reformulated fuels in terms of pollutant emissions.

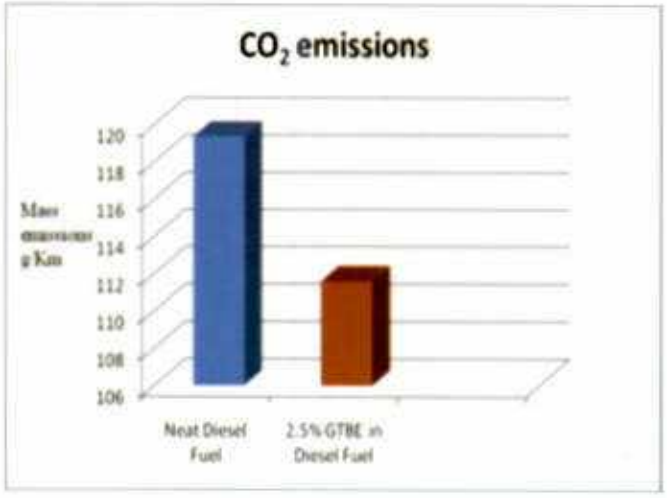
Following products have been developed for application:

(1) Bio-degradable base fluid(s) as metal working fluids and gear oil formulation.

(2) Oxygenated Compounds (GTBE) as additives for fuel formulation.

- **CO_2 Emissions Study from Neat Diesel and 2.5 % GTBE-blended Diesel**

The synthesized glycerol tertiary butyl ether (GTBE) was blended with commercial diesel of Euro-III standards. As GTBE is easily miscible with diesel, blending was carried out by mechanical stirring at room temperature. It was observed that CO_2 emission was quite lower with 2.5% GTBE-diesel blend as compared to neat diesel.



- **Production of Bio-diesel from Low-cost Feed-stocks Using Heterogeneous Catalyst**

➢ **Development of Heterogeneous Catalyst for Bio-diesel Production**

Trans-esterification using a conventional alkali process gives high conversion levels of triglycerides to their corresponding methyl esters in short time. The reaction has several drawbacks: it is energy-intensive; recovery of glycerin is difficult; the catalyst has to be removed from the product; alkaline waste-water requires treatment and free fatty acids and water interfere with the reaction. In order to minimize homogeneous process problem, development of heterogeneous catalyst for bio-diesel production is required.

We have:

- developed a process for bio-diesel production using non-edible and low-cost feed-stocks like PFAD, acid oils etc.
- done continuous trans-esterification studies in a new type of reactor for homogeneous and heterogeneous catalysts.
- The final report has been submitted to the DST.

- **Strategic Initiative to Develop Economical, Eco-friendly Lubricants from Low-cost Feed-stocks**

A brief objective of the study was on obtaining bio-lubricants from non-edible vegetable/acid oils for such applications as:

- Wind Turbine Gear Oils
- Marine Lubricants

The study envisages developing a technical knowledge base for development of bio-lubricants in an ecologically sensitive area. Thousands of kilometres of coastline constitute a great privilege, attracting significant tourism exchange. It is our national duty to keep our seas clean for all who make a living from marine & coastal wealth. The economic benefits will be in terms of bio-degradability & improved component life besides eco-safety. The approach is the first of its kind to the best of our knowledge.

The following activities were carried out:

- A total of 28 ester samples were synthesized and characterized for their physico-chemical properties like viscosity, density, pour point etc. A series of esters have been chemically modified by epoxidation for enhancement of the desired properties.

- **An Integrated Processing Method for Detoxification of Tree-Borne Oilseeds (PEOPLEHOPE)**

The demand for food/feedstuffs is increasing as the population is rising. The major part of vegetable oils was still being imported in India. India has a vast potential of tree-based oils which had so far remained untapped. Also, no commercial technology had so far been developed in this field of research. Hence, the development of technology for exploiting non-edible oils for edible and non-edible applications was seen as quite promising and was expected to grow fast in the next five years.

The following work was done:

- Six different seeds were collected from local areas around Dehradun. Seeds were extracted with n-hexane only. Same protocol was followed as set during the nodal lab discussion at CSIR-IIP.
- The extracted oil was-analyzed by GC; fatty acid composition was in the range of 16-18 carbon chain length.
- Based on physico-chemical properties the oil(s) seem(s) to be in use in other industrial applications.
- Collaborated with the Pantnagar University (Ranichauri Campus, Tehri Garwhal) for collection of different kinds of seeds of the Uttrakhand region.

- **Advanced Bio-fuels/Energy Products from Algae**

Microalgae are considered as one of the most promising feed-stocks for bio-fuels since they address the issues such as global warming, waning petroleum resources, require less land area and can grow on non-arable lands–thereby reducing the competition with food crops. This project aims to develop an innovative process for the economic and sustainable co-production of bio-diesel and energy products.

The following work was done:

- Screening of algal strains for high lipid content.
- Optimization of process parameters for high density cultivation.
- Algae oil extraction/ characterization of oil.
- Preliminary studies on conversion of algae oil to bio-fuels.

- **Development of Multi-functional Additives for Bio-fuels and Blended Fuels**

Around the world, there is a growing increase in bio-fuels consumption, mainly ethanol and bio-diesel as well as their blends with diesel that reduce the cost impact of bio-fuels while retaining some of the advantages of the bio-fuels.

Keeping the use of bio-fuels and bio-fuels blends in future in view, there is a need to develop the multi-functional additives to rectify the problems associated with their use as such or with hydrocarbon blends.

The following activities were carried out:

- Few additives for pour point and cloud point improvement were developed and tested with different blends of diesel-bio-diesel (B5, B10, B15, B20).
- Synthesis of Multi-functional additives initiated.

- **Development of New-generation Lubricants for Micro- Electro-Mechanical Systems (MEMS)**

The main objective of this study was the development of ester lube base-stocks for lubrication of MEMS, viz., watch oils, precision instrument oils, refrigerator compressors, sensors, optical circuits and in digital micro-mirrors.

The following work was carried out:

- New-generation lubricants were synthesized, analyzed, characterized and evaluated by using non-conventional eco-friendly indigenous commercial catalyst. Bio-degradability and toxicity of the synthesized products was also carried out.
- On the basis of the physico-chemical properties and tribological performance, two products showed interesting results for application as bio-degradable lubricants for clock-like mechanisms and precision instruments(IS:1088-2004). Data was compiled, patent filed and project report was submitted.
- M/s Titan Industries, Dehradun were given formulated watch oils for comparative analysis.

- **Study of the Molecular-level Interactions of Bio-lubes and Bio-additives**

We focussed mainly on the molecular level interactions of bio-lubes and additives using latest analytical techniques like GC-MS, GC, IR, H^1 and C^{13} NMR. Finally from these analytical data suitable structure-regulating

correlation to pour point, viscosity and oxidation stability were to be established.

The following activities were carried out for synthesis of bio-lubes as industrial gear oils and reference samples, and results obtained are summarized:

- Two mono- and three complex Polyol esters were synthesized.
- Two mono-ester products showed interesting results for application as bio-degradable reference samples.
- Three polyol products were found to have good potential for use as eco-friendly and bio-degradable base-stock for formulation as EP type of Industrial gear oil VG-68(IS-8406-2004).
- So far no lube base oils having mixed acids and complex esters as base oil, which is completely bio-degradable,were reported as industrial gear oils.

The advantages of synthesized ester lube base oil products are:

- ✓ High Purity
- ✓ Very high Viscosity Index
- ✓ Low Pour Point
- ✓ High Flash Point
- ✓ Low evaporation
- ✓ High thermo-oxidative stability
- ✓ Good anti-wear properties
- ✓ Good anti-friction properties
- ✓ Compatibility
- ✓ Bio-degradability

1.2.4 जैव–ईंधन प्रतिरूपण/Bio-fuel Modelling

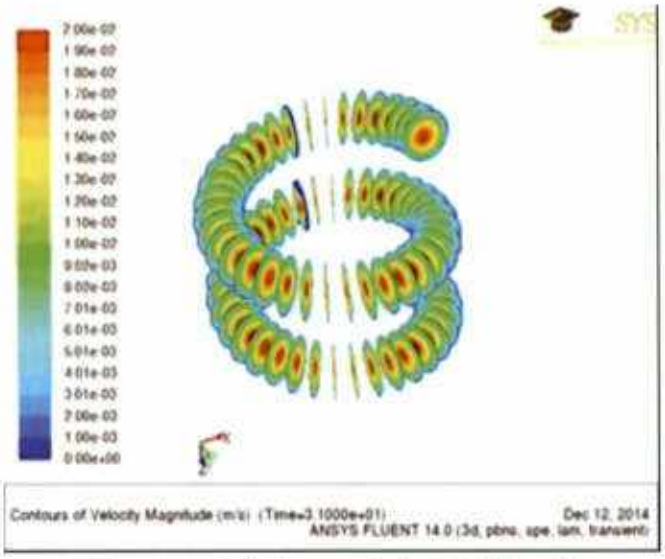
- **CFD Studies on Exploring the Possibilities of Using a Helical Coil Reactor for Trans-esterification**

Studies were being carried out to explore the possibility of using a helical coil reactor for trans-esterification of vegetable oil to make bio-diesel. Heat transfer and residence time distribution (RTD) studies using CFD modelling were carried out during 2014-15 to firm up the basis of this work.

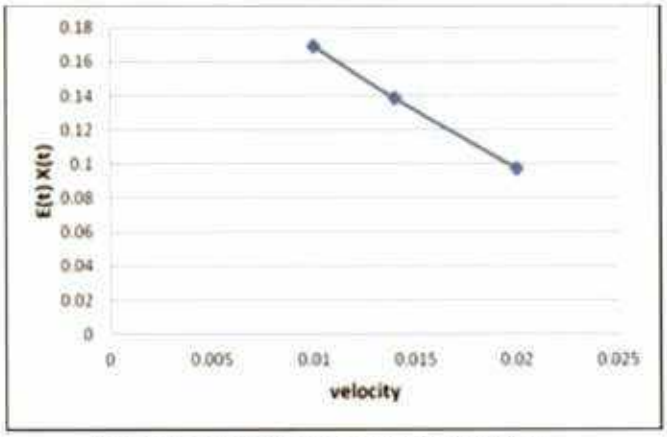
Experimental studies had also been carried out at the CSIR-IIP on a lab-scale set-up having glass coil. Efforts were made to simulate these lab data to develop the complete CFD model of a reactor.

RTD simulations were carried out by conducting numerical experiments using step response technique. Since no experimental data for kinetics study was available in-house, the mean conversions were predicted using literature data.

A research paper on work carried out so far is being compiled as a research paper and will be communicated soon to a suitable refereed journal



Contours of velocity magnitude inside the coil



Conversion at different liquid velocities (m/s)

1.3 रासायनिक विज्ञान/Chemical Sciences

- **Halogen-Free Ionic Liquids: New-Generation Energy-Efficient and Environmentally Friendly Lubricant Additives**

Need to conserve energy and to protect the environment has propelled an interest in the development of green and energy-efficient lubricants and lubricant additives. In this context, halogen-free Bis(imidazolium)- and bis(ammonium)-di[bis-(salicylato)borate] ionic liquids with variable alkyl chain and cyclic ring structures, were synthesized and then evaluated as potential lubricant additives. Introduction of halogen content in bis(imidazolium) ionic liquid by replacement of

bis(salicylato)borate (BScB) anion with hexafluorophosphate (PF_6), severely corroded the copper strip. The bis(ammonium)- and bis(imidazolium)-$(BScB)_2$ ionic liquids as additives significantly reduced both friction coefficient and wear of PEG 200. The structure of cations, particularly the variation in substituted alkyl chain length monitored the degree of reduction in friction and wear.

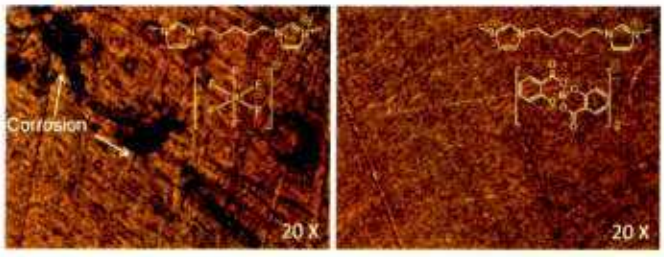


Figure 1: Demonstration of corrosion-inhibiting properties of halogen-free ionic liquids

In another piece of work, halogen-free chelated orthoborate ionic liquids were designed, synthesized and then evaluated as potential lubricant additives. The effect of the orthoborate anion structure on the thermal stability, corrosion, friction, and wear properties of ionic liquids was explored. The copper strip tests revealed the non-corrosiveness of bis(mandalato)borate (BMdB), BScB, and bis(malonato)borate (BMlB) anion-constituted ionic liquids. These ionic liquids as additives to the synthetic lube base oil significantly reduced both friction and wear. The degree of friction and wear reduction was influenced by the structure of associated anions. BMdB and BScB anion-constituted ionic liquids exhibited excellent thermal stability, friction reduction and anti-wear properties, which are attributed to their compact and chemically stable structure driven by higher inter-molecular interactions and rigidity of aromatic rings. The chemical analysis of tribo-interfaces suggested the formation of an ionic liquid-composed tribo-chemical product and that enhanced the lubrication properties. Being halogen-, phosphorus-, and sulphur-free, these ionic liquids (a) protect contact surfaces from tribo-corrosive events, (b) reduce the friction and wear, and (c) keep environment green and clean.

- **Chemically Functionalized *h*-Boron Nitride Nano-platelets: A Novel Material for Tribological Applications**

Energy and environment play important roles in everyone's life and are inextricably linked with each other. Global awareness on the sustainability of fuels, the need for energ-efficient systems and utilization/ conversion of energy in environmentally benign practices has been increasing immensely. In this context, the energy and material losses due to high friction and wear have been gaining huge interest. An efficient lubricant system can reduce these undesirable events. Hexagonal boron nitride (*h*-BN), an iso-electric analogous to graphene multilayer, can easily shear at the contact interfaces and exhibits excellent mechanical strength, higher thermal stability and resistance toward oxidation, which makes it a promising material for potential lubricant applications. However, the poor dispersibility of *h*-BN in lube base oil has been a major obstacle. The *h*-BN powder was exfoliated into *h*-BN nano-platelets (*h*-BNNPs), and then long alkyl chains were chemically grafted, targetting the basal plane defect and edge sites of *h*-BNNPs. The *h*-BNNPs-ODTES exhibit long-term dispersion stability in synthetic polyol ester lube base oil because of van der Waals interaction between the octadecyl chains of *h*-BNNPs-ODTES and alkyl functionalities of polyol ester. Micro- and macro-tribology results showed that *h*-BNNPs-ODTES, as an additive to synthetic polyol ester, significantly reduced both the friction and wear of steel disks. Elemental mapping of the worn area explicitly demonstrates the transfer of h-BNNPs-ODTES on the contact interfaces.

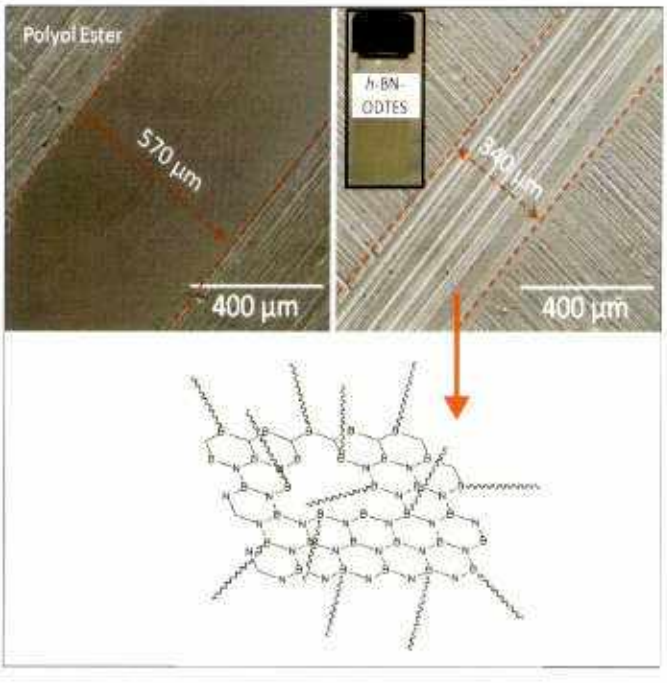


Figure 2: Demonstrating effect of chemically functionalized h-BNNPs on wear characteristics

- **Basal Plane Functionalized Alkylated Graphene Nano-sheets**

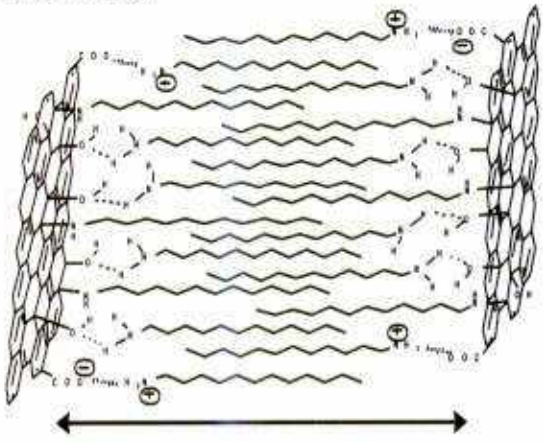
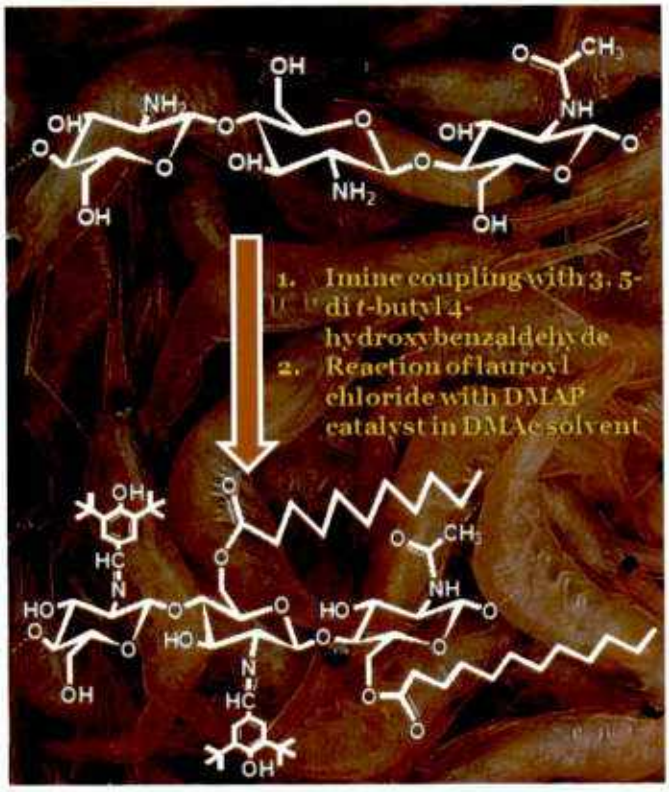


Figure 3: Bilayer structural model of graphene oxide framework material, where d-spacing is controlled by molecular pillars of n-alkylamines

A single-step facile approach for grafting of long alkyl chains in the basal plane of graphene oxide and simultaneous reduction of oxygen functionalities to restore the graphitic characteristics was developed to prepare graphene oxide framework materials. The van der Waals interaction between the octadecyl chains grafted on graphene and the alkyl chains of lube oils provided long-term dispersion stability to the alkylated graphene. The alkylated graphene, as an additive to the lube oil, decreased both friction and wear significantly under the sliding contacts. Micro-Raman results demonstrate the deposition of graphene nano-sheets on tribo-interfaces under sheared contact, and reduce the friction and protect the surfaces against undesirable wear.

- **Development of Eco-friendly Multi-functional Bio-lube Additive from Chitosan**

Acylated chitosan schiff base *ACSB-1* & *2* were synthesized via a two-step reaction pathway. First the chitosan schiff base (*CSB*) was prepared utilizing 3,5-di-*t*-butyl-4-hydroxybenzaldehyde. In the second step, esterification with lauroyl chloride catalyzed by 4-(dimethylamino)pyridine (DMAP) in N,N-dimethylacetamide (DMAc) solvent affords the final product acylated chitosan schiff base (*ACSB-1* & *2*). The synthesized compounds were evaluated as multi-functional additives for anti-oxidants and for lubricity properties in N-butyl palmitate/stearate. Rotating pressure vessel oxidation test (ASTM D2272) was used for evaluating anti-oxidant property. The thermo-



oxidative stability of N-butyl palmitate/stearate oil was increased 1.5 times by using this additive in 3000 ppm concentration of *ACSB-2* at 150 °C. Lubricity property was evaluated by using four-ball test (ASTM D4172A) which was performed at 75 °C temperature, frequency of 1200 rpm and 198 N load for 60 min. The lubricating efficiency of synthesized sample was estimated by measuring the average wear scar diameter (WSD). The WSD was also found to have decreased significantly by adding these compounds as additives in N-butyl palmitate/stearate. Both the samples passed the copper strip corrosion test (ASTM D130), too.

- **Amino-functionalized Nano-starch-Grafted Palladium Nano-particles-Catalyzed Base-free Direct Formylation of Aromatic Iodides using CO_2 as C1 Source**

Highly dispersed Pd-nano-particles grafted to amino-functionalized nano-crystalline starch were found to be excellent heterogeneous catalysts for the direct formylation of various aromatic iodides to their corresponding aldehydes in excellent yields without using any base. The developed catalyst could easily be recovered and recycled for several runs without any significant loss in activity and importantly, no metal leaching occurred during the reaction. Importantly, this was the first report on base-free direct formylation of aromatic halides using CO_2 as C1 carbon source.

- **Visible Light-assisted Photo-catalytic Reduction of CO_2 using Graphene Oxide-Supported Heteroleptic Ruthenium Complex**

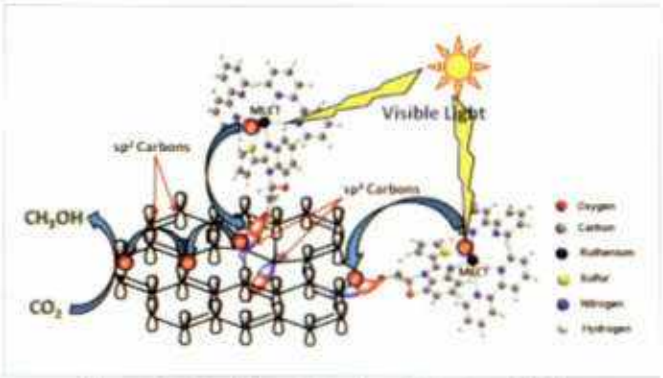


Figure 4: Possible mechanism of photo-reduction of CO_2 to methanol

We successfully developed and demonstrated a novel heteroleptic ruthenium(II) complex immobilized to graphene oxide as an efficient heterogeneous photo-catalyst for the photo-catalytic reduction of CO_2 to methanol without using sacrificial agent and under visible light irradiation (Figure 4). After photo-reduction, the catalyst was easily recovered by centrifugation and reused for subsequent runs. The recovered catalyst showed almost similar activity and provided similar yield of methanol in all the cases, which is a significant finding considering that immobilization of such photo-active complexes on suitable support is one of the major challenges for their practical exploitation. Importantly, the developed catalyst also does not require any sacrificial agent for photo-reduction of CO_2, which made the developed protocol further promising from both environmental and industrial viewpoints

- **Polymer-impregnated Sulphonated Carbon Composite Solid Acid Catalyst for Alkylation of Phenol With Methyl-Tert-Butyl Ether**

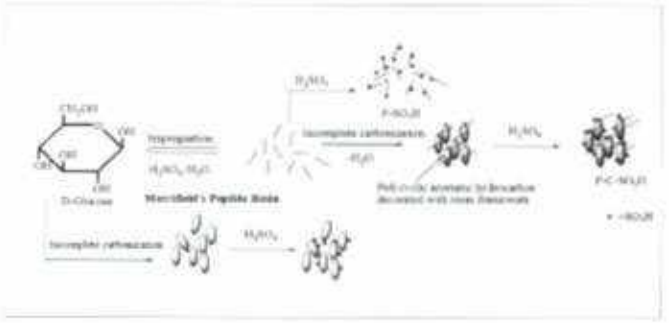


Figure 5: Synthesis of polymer-impregnated sulphonated carbon composite solid acid (P-C-SO3H)

Polymer-impregnated sulphonated carbon composite solid acid (P-C-SO_3H) catalyst (Figure 5) was synthesized via sulphonation of a composite material formed through incomplete carbonization of hydrolyzed glucose supported in a polymer matrix (co-polymer of styrene and chloromethylstyrene i.e. Merrifield's peptide resin) and used for alkylation of phenol using methyl-*tert*-butyl ether (MTBE) as an alkylating agent in a pressure reactor under autogenous pressure. The developed catalyst exhibited excellent catalytic activity and provided para-*tert*-butyl phenol (PTBP) exclusively with the added benefits of facile recovery and reusability for several runs without loss in catalytic activity

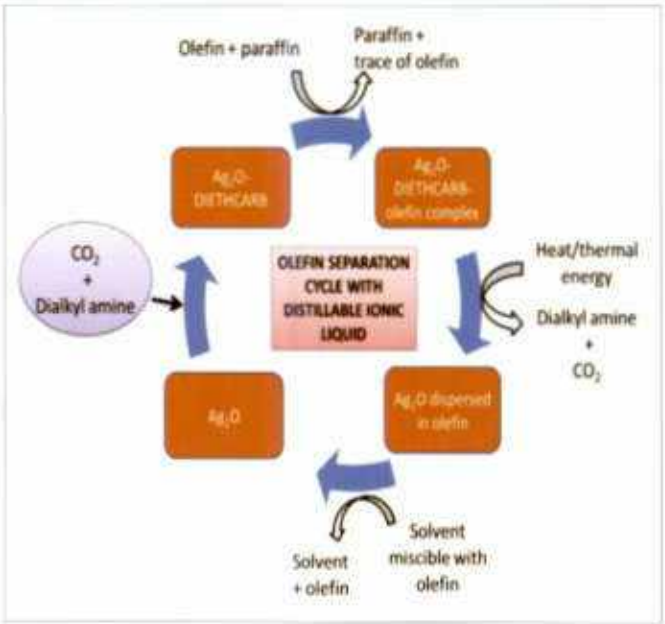
- **Synthesis of NMP from aq.MMA (monomethyl amine) and GBL (gamma-butyrolactone)**

N-methyl-2-pyrrolidone (NMP) is a versatile and highly useful chemical which finds large and diverse applications in a wide variety of end uses from electro-chemical to petro-chemical industries. The industrial preparation of NMP is predominantly carried out by reacting gamma-butyrolactone (GBL) with mono methylamine (MMA) in multiple tubular reactors at temperatures from 200 to 350°C and super atmospheric pressure about 5-10 MPa. The present invention provides an improved process for production of NMP comparatively at a milder operating condition in the presence of a catalyst which is recyclable without loss of activity for a number of runs and does not need regeneration frequently. The production of NMP can be performed at a less severe condition of temperature range of 150-250°C and pressure range of 0.5-3.0 MPa preferably in a single-stage batch-wise operation. The process was developed at lab-scale in batch-wise operations and was in progress to develop continuous mode.

- **Selective Extraction of Olefins from A Mixture of Hydrocarbons**

Olefins are an important building block for petrochemical products that we use in daily life. Olefins in the range of C_{10}-C_{14} are quite known to be used in detergent industries, while C_2-C_3 olefins are important as the base stock for polymer industries. Olefins in the range of C_2-C_4 are mainly produced from highly energy-intensive steam cracking of petroleum feed-stocks (naphtha, gas etc.) and also in part from fluid catalytic cracking and delayed coking of heavy petroleum residues. But the liquid streams in the range of kerosene or gas oil from those

thermal or catalytic crackers have not been exploited so much as they consist of quite good amount of olefins-most importantly alpha olefins. Cracked refinery streams are untapped sources of highly valuable olefins which need proper attention for refinery-petro-chemical integration.



The above scheme shows a concept of reversible complexation of silver agent with olefins from a mixture of hydrocarbons (olefin-paraffin mixture, for the simplest example). At silver-to-olefin molar ratio of 0.5-1.0, we got extraction selectivity for olefins up to 99%. Although the system works well as per the recyclability is concerned, the system seems less attracting due to cost issue associated with silver chemicals. So, we were trying to develop Cu-based systems in order to extract such valuable olefins selectively from cracked refinery feed-stocks e.g., coker gas oil C_9-C_{13} and C_{13}-C_{16} cuts which typically consist of 15-20% linear alpha olefins by weight. The Cu-based system was checked with LCGO C_9-C_{13} cut and found to be attractive. Experiments were under way for optimization of process parameters.

- **Iso-butylene to para-Xylene:**

Aromatization of such C_4 stream components–mainly isobutylene and butenes presently–has acquired a lot of importance due to increase in the demand for BTX. Para-Xylene being the most demanding building block of petro-chemicals, the conversion of butenes to *p*-Xylene is of the utmost importance. To produce *p*-Xylene from butenes, we worked with C_4 stream components under fixed-bed reactor conditions in the presence of heterogeneous catalysts. We were able to produce aromatics (BTX) substantially from isobutylene at operating temperatures comparatively lower than what has been stated in the prior literature. The key point in our system was the simultaneous production of 1, 3 butadiene (1-2%) in gas stream along with a high yield of aromatics up to 93-95% in the liquid product. The aromatic products mainly consist of BTX with up to 30-35% of *p*-Xylene and 35-40% of toluene. Fine-tuning of catalysts was under progress with feed stream consisting of mixed butenes.

- **Development of a Process for Normal Dodecane Fraction for IGCAR, Kalpakkam**

The project was under the sponsorship of IGCAR, Kalpakkam and the main objective of the project was to develop a process for production of normal Dodecane fraction from straight-run kerosene by non-aqueous urea adduction process. The process was developed successfully at lab scale and about 3 litres of normal Dodecane fraction were supplied to the sponsors. The supplied Dodecane fraction met the specifications of the sponsors successfully when tested at their end.

- **Development of Carbon Nano-tubes (CNTs) and Carbon Nano-granules (CNGs) From Vacuum Residue (VR-550+), and from Extracted Asphaltene and Maltene.**

Figure 6:
a) schematic diagram of project process
b) SEM image of synthsized carbon nano tube
c) SEM image of carbon nano-granules

Carbon nano-tubes (CNTs) are peculiar materials. They have been attracting intensive interest since their discovery. Several methods for their production or synthesis were developed: arc-discharge, laser ablation and vapour deposition. As one of the methods for large-scale production, catalytic chemical vapour deposition (CCVD or CVD) is believed to be promising. Methane and acetylene are common in producing carbon nano-tube in gaseous phase, while benzene, toluene, n-hexane,

xylene, and various aromatic compounds could also be candidates for the carbon source for synthesis of carbon nano-tubes. In order to examine a possibility of the use of heavy hydrocarbons as carbon source in producing carbon nano-tube with CVD method, we developed a reaction system for synthesis of carbon nano-tubes from VR-550+, asphaltene and maltene, which are complex mixtures of heavy hydrocarbons. Similarly, we were able to produce carbon nano-granules (CNGs) from the same hydrocarbon sources. The developed CNGs have shown a very good potential for the catalytic polymerization of methyl methacrylate and styrene.

- **Development of Copper-Loaded TiO_2 for the Photo-catalytic Reduction of CO_2**

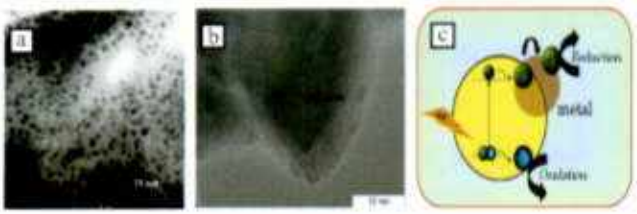


Figure 2:
a) TEM image of Copper nano-particles,
b) HR-TEM image of copper-loaded TiO_2 nano-particles
c) schematic diagram of photo-catalytic reaction

The continuous increment of anthropogenic CO_2 in environment is responsible for the global warming i.e. an increase in global temperature and it is also responsible for other climatic changes. Moreover it is an opportunity filled with challenges to employ anthropogenic CO_2 as feed-stock for chemicals and fuel synthesis. CO_2 can be transformed into different organic compounds as carbonates and poly-carbonates on reaction with epoxides, as well as it can be used for production of CO, CH_4, HCHO, HCOOH and CH_3OH by reduction. CO_2 reduction can be done in many ways as electro-chemical reduction, hydrogenation at high temperature, light-induced photo-chemical reduction. The photo-catalytic reduction of CO_2 is the best tool, because it uses abundant sources of energy and water to reduce CO_2 to hydrocarbons. Here, we developed a series of catalysts with the loading of *ex-situ* generated carbon nano-particle on lab-synthesized TiO_2 nano-particles. We have observed very good photo-catalytic reduction of CO_2 to CO. The maximum rate of CO generation was observed 172μmol/g/h with reduced $Cu_{1\%}$-TiO_2 catalyst.

1.4 वैश्लेषिक विज्ञान/ Analytical Sciences

The Advanced Crude (Oil) Research Centre of the Institute (ACRC) performs crude oil assay and detailed hydrocarbon feedstock analyses and evaluation. The ACRC crude oil assay labs are staffed with expert petroleum scientists and have state-of-the art instruments. Crude oil assay testing includes crude oil characterization of the whole crude oil and the boiling-range fractions produced from physical distillation by various procedures. Petroleum assay data is used by clients for detailed refinery engineering and crude oil marketing. Feedstock assay data helps refineries optimize the refining process. Atmospheric and vacuum distillations produce distillate fractions and residual bottoms similar to the actual refining process. The analysis of crude oil general properties produces data including the sulphur content, nitrogen content, viscosity measurements, cold property measurements and metals content. ACRC carried out the assay of the following crude oils.

- **Studies on Crude Oils**

A client sponsored a project for evaluation of two RJ crude oils from Rajasthan's Barmer fields and two Gujarat light crude oils being explored by them. The evaluation study was aimed at determining the bench-mark pricing of crude oil samples.

- **Study of Condensate Samples of Different Fields**

A detailed report was prepared on characterization and compositional aspects of condensate samples from ONGC to investigate their price fixing and for value-added products.

- **Stock Loss Studies on HSD/SKO from HPCL, Mumbai**

This project of national importance involving the country's economy and health, included scientific studies at different petrol pumps throughout the country to calculate the loss of HSD and SKO.

1.5 ऑटोमोटिव ईंधन एवं स्नेहक अनुप्रयोग/ Automotive Fuels And Lubricants Application

- **Application of Gaseous Fuels in Compression Ignition Engine**

Gaseous fuels are traditionally used in spark-ignited (SI) engines. SI engines are less efficient than Compression

ignition (CI) engines and, therefore, it would be beneficial to use the gaseous fuels in CI engines. Liquefied petroleum gas (LPG) and dimethyl ether (DME) were successfully test-combusted in a single cylinder CI engine in dual-fuel mode. Gaseous fuel was inducted through the intake manifold through specially-designed gas-air mixture and gaseous fuelling system while diesel was directly injected into the combustion chamber. Diesel replacement of around 70% by gaseous fuel can be achieved in the dual-fuel mode. There was tremendous reduction in the harmful NOx emissions and significant reduction in engine smoke. NOx and smoke emissions are pollutants of major concern in CI engines and it is difficult to reduce both NOx and Smoke simultaneously because of the NOx-PM trade-off. The engine noise was also greatly reduced in the dual-fuel engine. However, CO and HC emissions increased and future work needed to be carried out on optimizing these two emissions. The emissions of NOx and Smoke using DME-LPG-diesel and LPG-diesel are shown in the following Fig. 1-2. Diesel fuel consumption in dual-fuel mode with different gaseous fuels is shown in Fig. 3. The findings of the research show that gaseous fuels can be effectively and efficiently used in CI engines with significant efficiency increase as compared to SI engine while at the same time achieving reduced emissions.

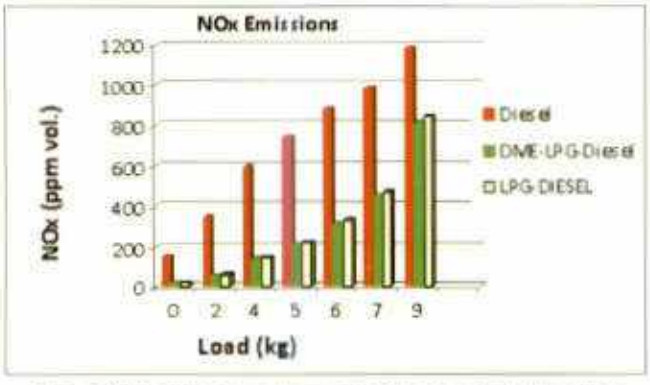


Fig. 1 NOx emissions of gaseous fuels used in CI engines

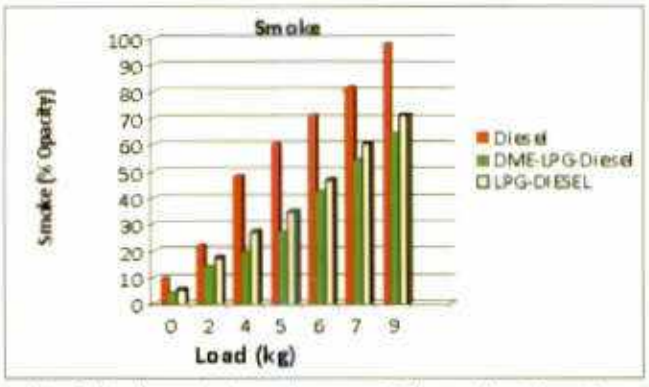


Fig. 2 Smoke emissions of gaseous fuels used in CI engines

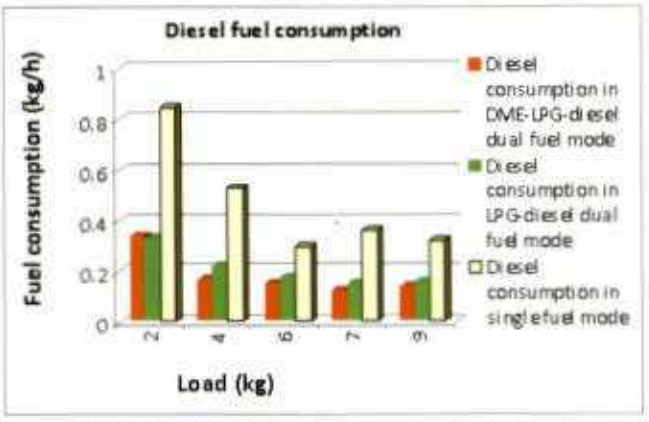


Fig. 3 Diesel fuel consumption in single-fuel mode and dual-fuel mode

- **Material Compatibility and Emission Performance Measurement with the Ethanol Blended Gasoline (E20)**

Vehicle fuel system is vital with respect to optimum intended design features including emissions, drivability performance, safety requirements, etc. It is, therefore, of the utmost importance to know the impact of the use of the modified fuel for assessing whether the fuel system will be able to perform as intended for the complete design life of the system. Therefore, before using higher ethanol gasoline blend like E20 as a fuel, it is essential to study its impact on existing material system for their compatibility for both old and new vehicles. The impact on the in-use vehicles is important, in particular in the Indian context, where more than 10-year-old such vehicles are plying, which may not have been designed for the higher ethanol gasoline blend like E20.

Due to the lack of information on material compatibility with higher ethanol blends in Indian context, actual experiments are necessary to address issues related to material compatibility. Earlier study was carried out with 10 % ethanol blend on material compatibility of metals, non-metals, mass emissions & evaporative emissions.

In view of this, a study was proposed to be carried out with 20% of ethanol blend on old and new vehicles with respect to performance, fuel economy, material compatibility and emission characteristics.

The proposed work on E20 was expected as an important step towards increasing the percentage share of renewable fuels in automotive sector. Effect of E20 on emissions, performance and existing materials used in vehicles would be studied and new material suitable for E20 fuel may also be proposed.

- **Application of DME 20 Fuel in a Gasoline Passenger Car to comply with Euro-Emission Legislation**

In this study, a gasoline passenger car (Euro IV) was investigated for performance and emissions on three different fuels i.e. Gasoline Auto LPG and DME blend with concentration of 20% by mass in Auto LPG (DME20). In particular, emission characteristics (including hydrocarbon, CO, NOx and CO_2) over the Modified Indian Driving Cycle (MIDC) and fuel economy were investigated. The experimental results showed that the vehicles comply with Euro IV legislation on gasoline while LPG fuel showed higher NOx Emissions on DME 20 fuel. LPG kit was reconfigured for DME and LPG blend to bring down the emission within the specified emission limits. The emission values observed for DME 20 were 0.635 g/km (CO), 0,044 g/km (THC), and 0.014 g/km (NOx) against the Euro IV limits of 1.0 g/km, 0.1 g/km and 0.08 g/km, respectively. The vehicle drivability over the Modified Indian Driving Cycle (MIDC) was comparable for DME 20 with gasoline, and auto LPG fuel vehicle could achieve the maximum acceleration and speed of the MIDC.

(a) Applicaton of DME fuel (a)

Applicaton of DME fuel (b&c)

1.6 ट्राइबॉलॉजी (घर्षणापघर्षण शास्त्र) एवं दहन/ Tribology & Combustion

1.6.1 घर्षणापघर्षण शास्त्र/Tribology

- **A Parametric Investigation on the Micro-elasto-Hydro-dynamic Lubrication of Power Law Fluid Lubricated Line Contact**

A parametric study of micro-elasto-hydro-dynamic lubrication (EHL) contact between rough cylinder and plane lubricated with non-Newtonian Power law fluid was carried out. A Gaussian rough surface was considered and modelled using stochastic approach. A theoretical solution of pressure distribution, fluid film thickness and friction for given speeds, material properties, slide-to-roll ratio and power law index, was obtained by solution of Reynolds equation using FEM techniques. An isotropic roughness pattern is considered and results obtained for a wide range of operating parameters. The results indicated that the shear-thickening fluids provide thicker lubricant films as compared to shear-thinning fluids. The minimum fluid film thickness is observed to decrease with an increase of load and it increases with an increase of speed and material parameter. Slide-to-roll ratio has a marginal influence of the minimum film thickness. Under certain operating conditions softer materials with shear thickening lubricants yield thicker lubricant films than the harder materials lubricated with shear-thinning fluids. The coefficient of friction, too, is influenced by the rheology of lubricants with shear thinning fluids providing larger values of coefficient of friction than the shear-thickening fluids.

- **Study on Compatibility Behaviour of New-Generation Lubricants with Engineering Materials**

The new-generation lubricants of the type of nano-fluids and the lubricants synthesized using bio- and synthetic base-stocks are very much different in performance than the mineral-based lubricants. However, the testing methodology adopted for these lubricants was the same as that for mineral-based oils with steel-on-steel contact. Compatibility of lubricants with materials in contact has become a critical problem as the contact life is largely dependent on the compatibility of lubricant with the contacting materials. In this context, the research project aimed to develop the synergy charts on the basis of compatibility studies between the new-generation lubricants and materials. A variety of nano-fluids and bio-

based lubricants were synthesized and their tribological performance in terms of friction and wear behaviour was investigated. The engineering materials of the type of alloys, ceramics and textured surfaces were extensively studied. Further, the influence of operating conditions on the performance of the lubricants was being investigated.

- **Thin-film Lubrication for Micro-machine Elements under Robotic and Micro-machine (ROLLM)**

Micro-machine tools are the systems used to produce miniature devices. These systems consist of micro-scale movable mechanical elements manufactured from various micro-fabrication processes. Friction and wear between the interacting surfaces limits the lifetime of the components. The smaller the elements are, higher the friction is expected to be. In context to this, this project aimed to develop thin lubricant films for micro-machine tools and assess their performance over a wide range of operating conditions. Hence, a variety of organic and inorganic compounds were synthesized to be coated on the steel substrates of MEMS components. The polymers and metal pthalocyanines were synthesized & characterized for their physcio-chemical properties. The developed compounds were coated on the steel substrates prior to their tribo-testing.

- **Indo-US Joint Center on Elasto-hydro-dynamic Lubrication Studies**

The micro-EHL phenomenon responsible for the micro pitting and scuffing failures associated with the gears and bearings in contact is being investigated. Theoretical models for simulation of transient, lubricated with non-Newtonian lubricant micro-EHL phenomena, were developed and the performance of the contact investigated. Further experimental procedures were followed to investigate the influence of surface texture on the performance of micro-EHL contact.

- **Wear-rate Measurement in Automobile Gearbox using Twin-Disc Tribo-tester through Thin-layer Activation Technique**

Wear of the gearboxes is a critical issue. The wear of gears causes imprecise transfer of power which again leads to the loss of power. Gear wear is a slow process and at the initial stage when the wear particles are small, it is very difficult to predict and arrest failures. In this context, the project work aimed at developing an online wear-monitoring strategy for gears using TLA (Thin Layer Activation) Technique. In this context, experiments on the measurement of wear rate were performed on the irradiated steel disc specimens. Further experiments were performed to investigate the influence of load, speed and temperature on the wear behaviour of the discs in contact. Experiments for investigating the influence of lubricants on the performance of the contact were planned.

1.6.2 दहन/Combustion

- **Combustion Studies of LPG-DME Blends and Design of Dedicated Domestic Burner**

A review of current Indian market indicates that indigenous production of LPG has not been able to keep pace with the increasing demand. In the present average yields obtained from the Indian refineries, LPG accounts for only 4.5% of the crude oil processed. Hence, in spite of the recent discoveries of gas and the major refinery projects being undertaken, there will be a shortage of LPG, at least in the near future. To cope up with the current situation of LPG demand, DME-blended LPG has been identified as a potential substitute for the domestic LPG usage. DME combustion has been subject to numerous experimental and numerical studies. In this context, an equilibrium combustion model was developed to study the combustion of LPG/DME blends to determine thermal properties such as specific heats, enthalpy, entropy and adiabatic flame temperature of mixture obtained after combustion.DME and LPG are not completely interchangeable for stove application. However, work carried out in this direction shows that the mixture of DME and LPG (15-20 vol.% of DME) under specific conditions shows better results as compared to pure DME.

- **Development of Improved PNG (Piped Natural Gas) Domestic Burner**

Natural gas has been extensively used as a fuel in many heating applications. In particular, natural gas is recognized as one of the most important cooking fuels for domestic gas burners. In context to this, theoretical CFD-based studies were performed to investigate the performance of burners operating with Natural Gas. Further, a thermal efficiency test set-up was designed for NG in which NG from high pressure (CNG) could be directly fed at very low pressure. The designed set-up would be used to conduct studies on NG burner performance under various operating and design parameters.

- **Development of Technology for Upgradation of Bio-gas to Transportation and Cooking Fuels**

The R&D in the area of bio-gas aims at reducing the gestation period and enhance the quality of the bio-gas for higher thermal efficiency. The bio-gas generated was also investigated for its probable applications as transportation fuel. Necessary modifications and technological challenges were addressed to achieve the desired goals.

- **Development of Energy Efficient *Chulha* for Rural Application**

This research work aimed at the improvement of *chulha* used in the rural households of India. Different qualities of wood obtained in Indian terrain used for combustion were studied and their combustion characteristics were identified. Further development of low-cost efficient bio-mass stove *chulha* was in progress.

- **Comparative Testing of Tribological Properties of Russian and Indian Main Gearbox Lubricating Oil**

This project involved comparative studies of Russian and Indian gearbox lubricating oils for tribological performance. This study would provide important information for selection of gear oil for the Indian Air Force.

- **Testing of RDSO (Research Designs and Standards Organization) Lubricant Sample**

The project involved the comparative testing and evaluation of the lubricants to be used in Indian Railways. On the basis of the performance testing the suitability of lubricants for successful operation in the Railways was decided.

- **10-metre Cube /day Capacity Bio-gas Plant**

A-10 metre cube/day capacity bio-gas plant was installed as an initiative towards development of technology for the upgradation of bio-gas to cooking and transportation fuels. The bio-gas produced would be used for conducting research on bio-gas production, purification and applications. Excess bio-gas will be used in the Institute canteen for cooking purposes. The plant would aid in the disposal of bio-waste of the laboratory, canteen and staff colony.

Figure 1: Bio-gas plant installed at CSIR-IIP.

1.7 निदेशक का अनुसंधान प्रभाग/ Director's Research Division

1.7.1 अधिशोषण एवं झिल्ली पृथक्करण/ Adsorption and Membrane Separation

- **Technology Development for Adsorbed Natural Gas**

Natural gas is a preferred transportation fuel due to its lower cost, increased availability and clean burning characteristics. As a vehicular fuel, natural gas is used in the form of CNG (Compressed Natural Gas). However, it has many drawbacks also in terms of high storage pressure to achieve high energy density and shape restrictions for storage vessel/cylinder etc. One strategy for maintaining similar energy density of CNG but under reduced pressure is by applying the concept of Adsorbed Natural Gas (ANG). Here natural gas is stored in a special micro-porous material placed inside the pressure vessel.

The project planned to develop MOF-based sorbent materials having sufficient methane gas storage capacity at moderate pressure and ambient temperature and with a deliverability of methane greater than 95 % of the storage capacity for use as a transportation fuel under standard operating conditions.

The work carried out so far involved screening of large numbers of different classes of adsorbent materials by determining their equilibrium adsorption capacities and regenerability.

Based on the screening and evaluation of different adsorbent materials, few adsorbents were selected as potential adsorbents for further studies in a custom built dynamic adsorption and discharge unit.

Dynamic adsorption and discharge Unit

Gravimetric equilibrium capacity of methane was measured in a state-of-the-art micro-balance with different adsorbents. The gravimetric capacities were then converted to volumetric capacities using surface and particle properties of the adsorbents evaluated. The results are shown in Figs 1 and 2.

Based on volumetric uptake measurements CPO-27Ni was selected for multi-cycle adsorption discharge studies in a custom-designed high pressure adsorption unit. The results indicate good cyclic stability of CPO-27Ni for methane storage and discharge (Fig.-3). The temperature profile of the discharge step was simulated by an in-house developed mathematical model. The mathematical model developed describes methane discharge behaviour of an adsorbent-packed insulated column. The model has two components namely:

(i) Equation of continuity

(ii) The energy balance equation

These partial differential equations along with initial and boundary conditions are first non-dimensionalized and then discretized using the Crank-Nicholson method into differential algebraic equation (DAEs). These DAEs are simultaneously solved using Excel-based solver. The model fit of experimental data is shown in Fig.-4.

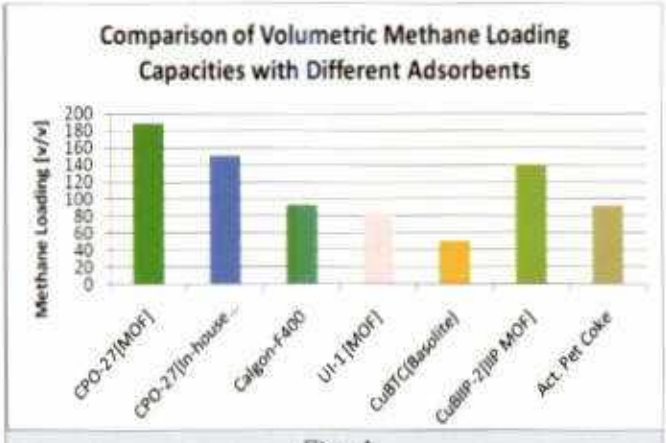


Fig. -1

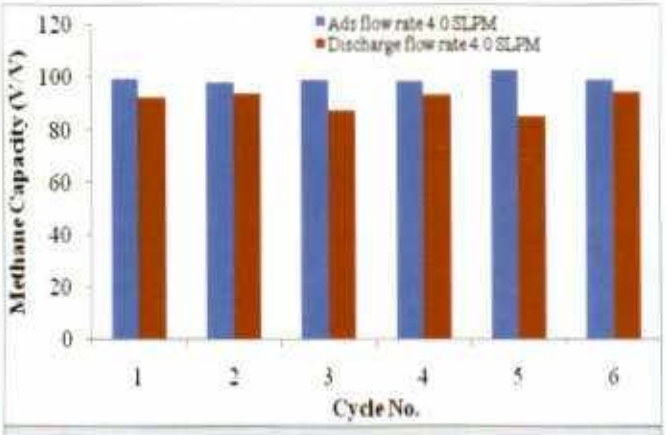


Fig. -3

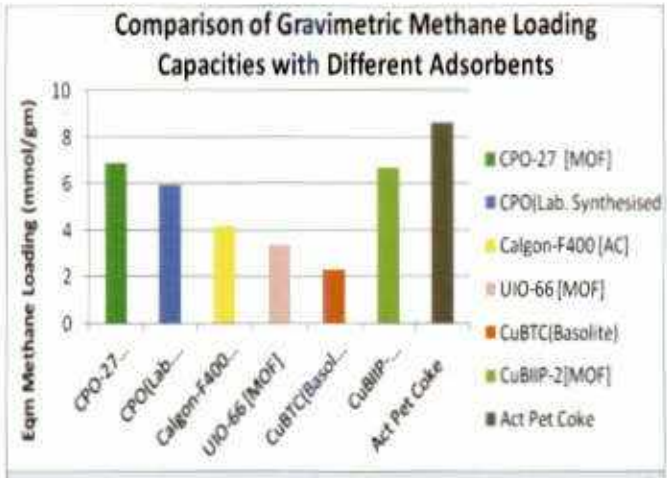


Fig. -2

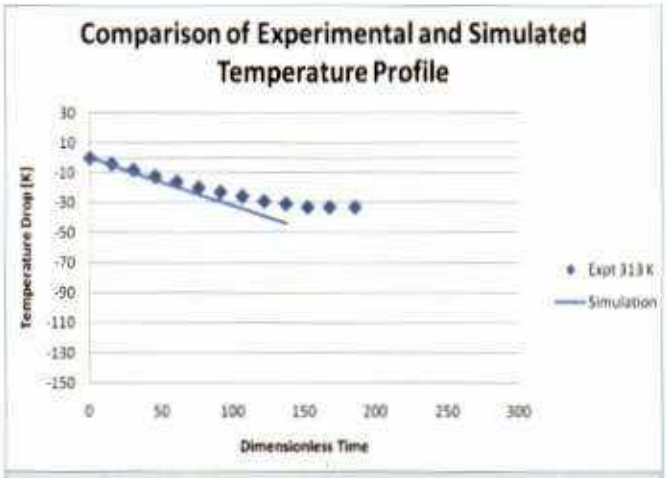


Fig. -4

- **Development of a VSA Technology for Simultaneous Production of High-purity CO_2 and H_2 from the H_2 PSA tail gas of a Petroleum Refinery**

The objective of the project is to develop an adsorption-based process for simultaneous recovery of CO_2 and H_2 from PSA tail gas in order to decrease overall CO_2 footprint of a petroleum refinery.

Commercial adsorbents including activated carbon and zeolites were screened based on their equilibrium adsorption capacity for CO_2, CH_4 and H_2.

Based on screening results two different classes of adsorbents were tested in a two-column VSA unit in layered bed configuration using a simple Skarstrom-type cycle under different operating conditions of feed flow rate and pressure. VSA performance is assessed by determining product yield and purity (Figures 5 and 6)

The preliminary results indicated that at adsorption time of 252 seconds, around 96% H_2 and 84% CO_2 purity respectively is obtained.

- **Adsorption-based Separation of Propane and Propylene**

Our objective was to develop suitable adsorbents and to develop pressure/vacuum swing adsorption process for separation of propylene in high purity for petro-chemical applications from propane-propylene feed mixture.

- Synthesis of adsorbent materials based on Zeolites, MOFs, ETS and MOF composites characterization of these adsorbents by SA, PSD and XRD measurements.
- Synthesized as well as commercially available adsorbents were screened based on equilibrium isotherm measurements (Fig.7A & B).

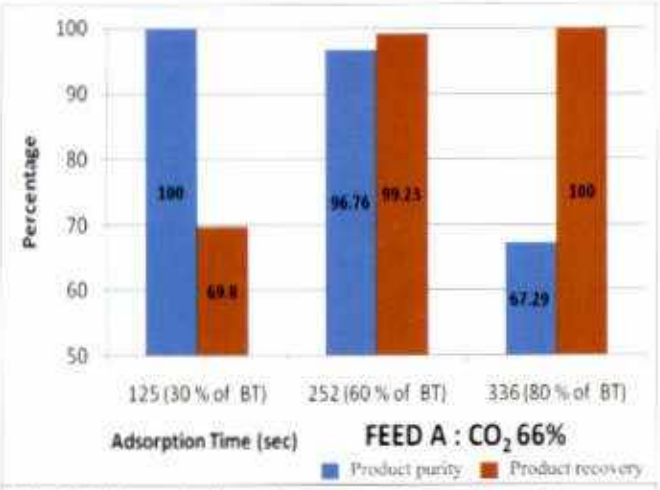


Fig-5: Effect of adsorption time on H_2 purity and recovery

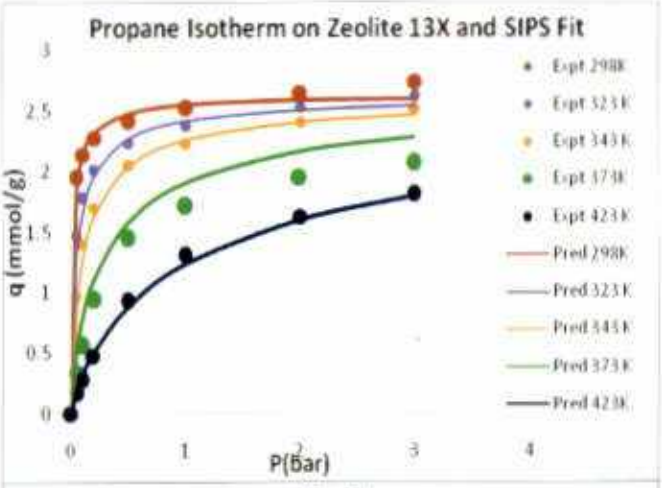


Fig-7A

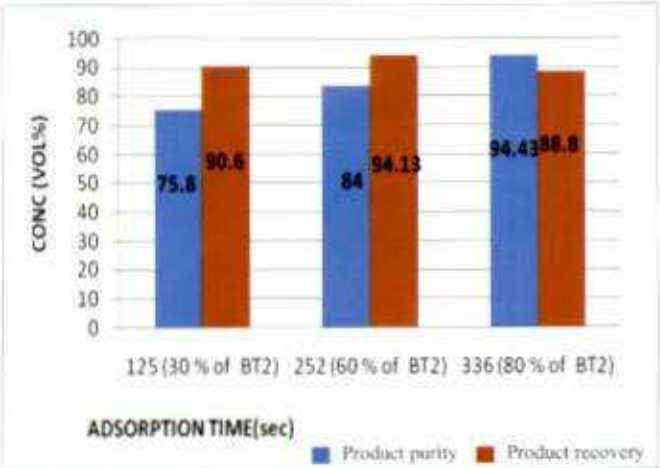


Fig-6: Effect of adsorption time on CO_2 purity and recovery

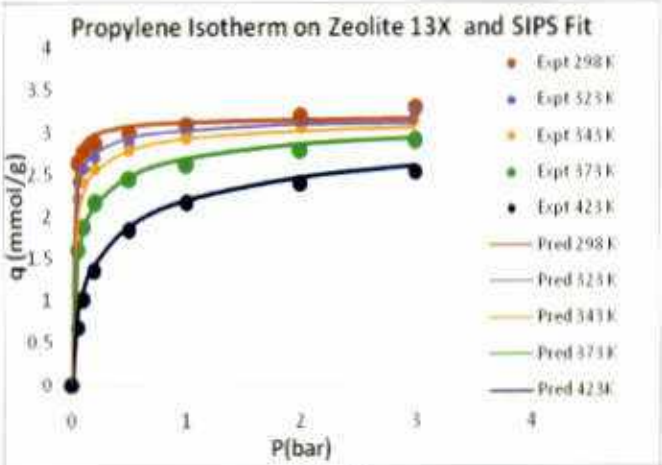


Fig-7B

- An in-house developed multi-component isotherm model based on Langmuir-IAST theory was upgraded for inclusion of DSL and SIP single-component isotherm parameters. This model was tested for determining multi- component propylene/propane selectivity (Fig. 8).
- Upgradation of an existing micro-adsorber unit was initiated to handle flammable gases like propane-propylene mixtures.

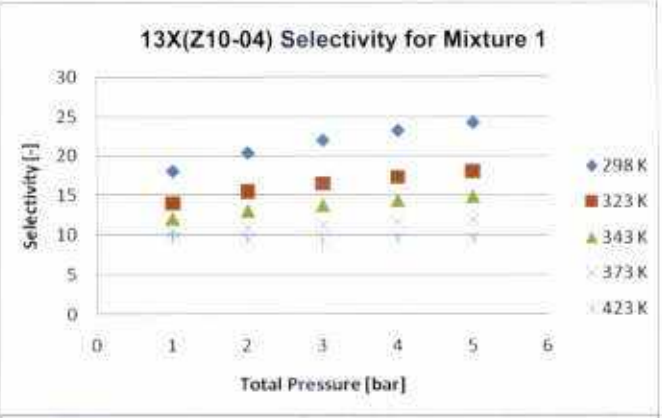


Fig-8

Based on equilibrium uptake measurements, low propylene/propane loading ratio was observed; however, 13X zeolite multi-component selectivity determined by IAST-SIP model showed a very good selectivity value in the range of 10-25 depending on temperature and pressure conditions.

- **Development of Membrane Technology for Hydrogen Recovery from Low Hydrogen-Bearing Refinery Off Gases (*CSIR-IIP-NCL-CGCRI*)**

The aim was to develop a membrane-based process that could recover hydrogen from refinery off-gas/PSA tail gas containing minimum 20% hydrogen to provide an enriched hydrogen stream containing at least 70% hydrogen suitable for recycling (to hydrogen PSA plant in the refinery)

Single-gas permeability of H_2, N_2, CO_2 and CH_4 was measured with PBI, PS, CMS and hollow fibre membranes supplied by NCL, Pune and CGCRI, Kolkata reported in Figs 9-12.

The results were compared with literature reports and found to be in the reported range.

The PBI and PS membranes were found to be selective for H_2 and CO_2 over N_2 and CH_4.

For CMS membranes, H_2/CO_2 and H_2/N_2 selectivity of 2.6 and 2.3 respectively was observed at 2 bar pressure.

Selectivity over 70 was observed with PS hollow fibre H_2/CO_2 module for and H_2/N_2 binary system.

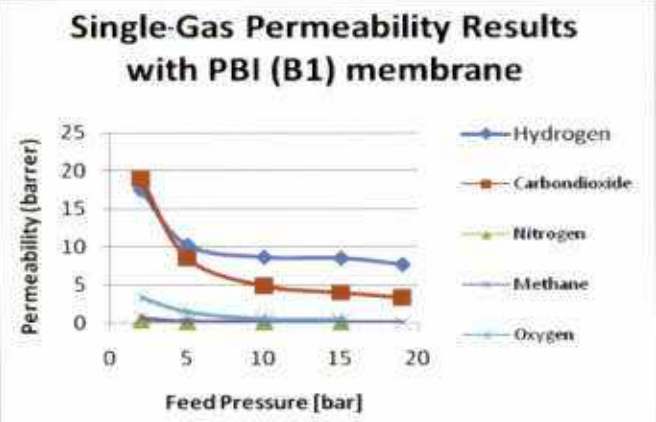


Fig-9

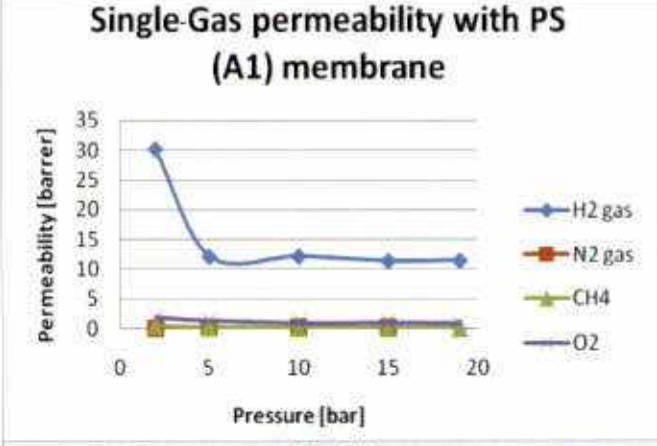


Fig-10

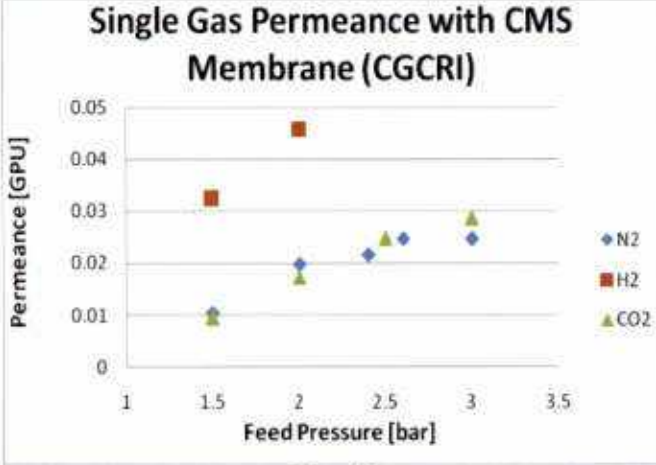


Fig. -11

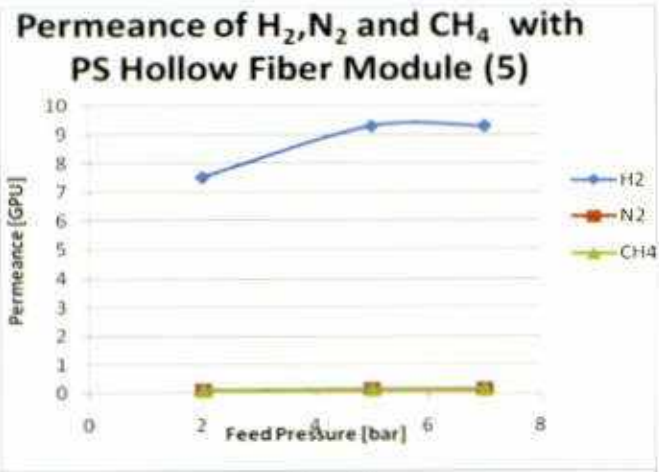


Fig. -12

A view of the Numaligarh Refinery Wax Plant

1.7.2 ल्यूब, बिटुमेन, कार्बन सामग्री एवं मोम/Lubes, Bitumen, Carbon Materials and Wax

- **Commissioning of Wax Plant at Numaligarh Refinery Limited (NRL)**

'Wax Deoiling Technology' was developed in association with Engineers India Ltd (EIL). Numaligarh Refinery Ltd (NRL) has been setting up a state-of-the-art grass-roots Wax Deoiling Plant at the NRL. This was the first wax plant to be set up based on indigenous technology in the country. This newly set up plant would produce 50,000 MTPA of high-value 'paraffin wax' and 4,500 MTPA of 'micro-crystalline wax'. Paraffin wax is used for making candles, polishes, medicines, food packaging, paints, tyres, leather etc, while micro-crystalline wax is mainly used in the cosmetic industry. The commissioning of the wax plant was completed. Salient Features of the CSIR-IIP & EIL 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 and continuous process back-up etc.
- Novel solvent recovery system designed to eliminate furnace requirement.

- **Training Programmes and Technical Support Provided by the Institute on Numaligarh Refinery Wax Plant**

- A training programme on the wax plant at the NRL Refinery was organised by the CSIR, IIP and EIL during 12th to 15th May, 2014 for more for than 100 Engineers and Operating Personnel at NRL. This training programme was on Fundamentals of Wax Deoiling Operation, Plant Design, Operation and Troubleshooting and many more aspects of the wax plant.
- Special training programme on analytical procedures for Numaligarh wax plant personnel was conducted at the Institute during 26th-27th June, 2014. Quality control personnel along with some plant personnel from Numaligarh Wax plant were given hands-on training on analytical test procedures for wax characterization along with class-room lectures on Wax Deoiling Technology.
- The CSIR-IIP team participated in the pre-commissioning activities of the NRL wax plant in the month of October, 2014.
- The CSIR-IIP extended support in setting up of a wax laboratory in the Quality Control Department of the Numaligarh Refinery and on-site training of various quality control test procedures for paraffin wax was also imparted to the NRL Personnel.
- The CSIR-IIP participated several times in the commissioning activities in the Numaligarh Refinery Solvent Deoiling Unit between November, 2014 and March, 2015 and solved several operational problems.

- **MIBK Dewaxing/Deoiling Studies on PWD (370-482 AET Cut) & Foots Oil (Dewaxed Oil) for Digboi Refinery**

The main objective of this study was to carry out MIBK Dewaxing/Deoiling on PWD (370-482°C Atmospheric Equivalent Temperature Cut) and Foots Oil of PWD stream (Dewaxed Oil) from Solvent Deoiling Unit of Digboi Refinery to establish the relationship between deoiling temperature and wax yield. The broad findings of the study were as follows:

- ⇨ Reduction in filtration temperature to 3°C in PWD processing shows 1.3% wt improvement in wax yield during lab investigations
- ⇨ Wax quality was almost at par in both of the filtration temperatures, fulfilling BIS Type -1 requirement with respect to oil content and melting point
- ⇨ Foots Oil pour point reduced to 15°C and in the case of PWD processing to 3°C
- ⇨ 4.4% wt of low-melting and high-oil content wax was extracted in Dewaxing of PWD Foots Oil.
- ⇨ Pour Point of Dewaxed Foots Oil was 9°C

- **Study for Value-creation of Bottom 502°C plus Material of CSO ex-RIL**

Clarified slurry oil (CSO) is the bottom product FCCU and is obtained from petroleum refineries. All refiners have a challenge to get value-added products from CSO. M/s Reliance Industries Ltd (RIL) sponsored a project for value-creation of bottom 502°C plus material of CSO.

The Institute carried out a study to make petroleum pitch from CSO for its value addition. Pitch is a specialty product and is used for a wide variety of industrial applications. Pitches of various types (e.g., isotropic pitch, mesophase pitch) are used for a wide variety of applications; these are the starting materials for making high-value carbon products such as carbon anodes required for aluminum production, graphite electrodes required for steel production and for making carbon fibres, carbon-carbon composites and mesocarbon microbeads (MCMB) for making li-ion battery anodes etc.

This study showed that value creation of bottom 502°C plus material of CSO is possible by making valuable isotropic and mesophase pitches from this. The pitches prepared can be utilized for making industrial and advanced carbon materials. The feasibility study confirmed that value-creation of bottom 502°C plus material of CSO is possible by producing isotropic pitch. It is possible to produce 'isotropic pitch' from bottom 502°C plus material of CSO by suitable thermal treatment. The pitch sample has softening point (70°C), coking value (47% wt), toluene insolubles (6.91% wt) and quinoline insolubles (0.23% wt). This pitch has low softening point and is isotropic in nature. This pitch can be used as starting material for making 'mesophase pitches' as well as 'impregnating pitches' for making carbon and graphite electrodes. The study also confirmed that bottom 502°C plus material of CSO is a potential feed-stock for producing the mesophase pitch. It is possible to produce mesophase pitches having different physico-chemical properties and mesophase content. The bulk mesophase pitch has softening point (146°C), coking value (65.30% wt), toluene insolubles (41.12% wt) and quinoline insolubles (5.35% wt). This pitch has high softening point and is anisotropic in nature (mesophase). This mesophase pitch can be used for making high-priced needle coke.

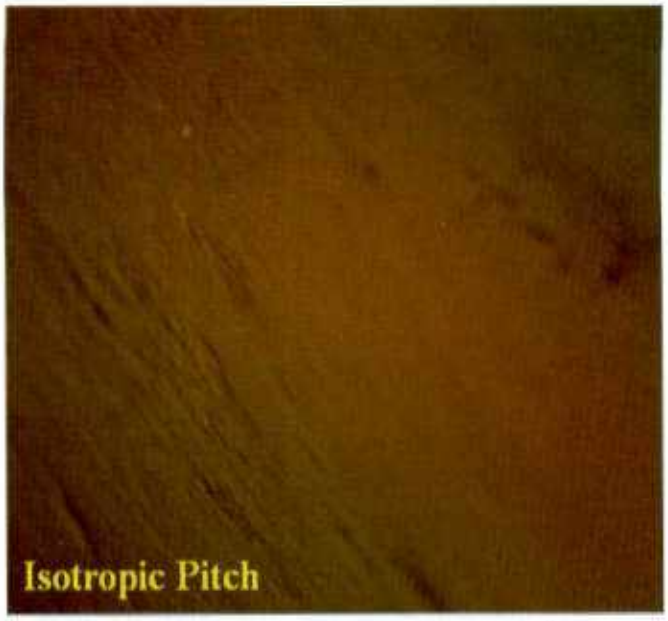


Figure : Optical micrograph of isotropic pitch

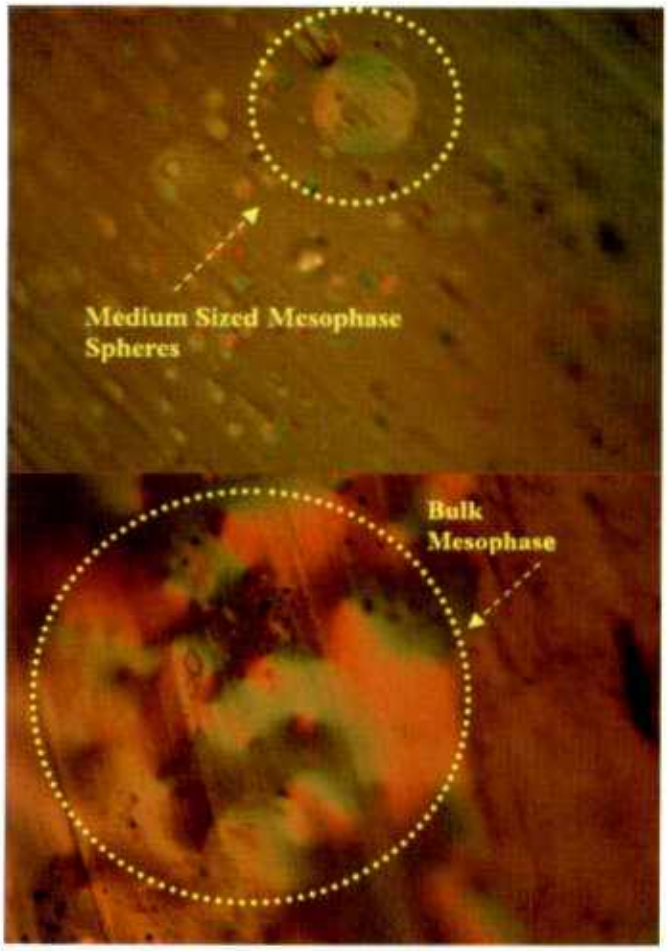


Figure : Optical micrographs of mesophase pitch

- **Feasibility Study for Making Zero-Pen Bitumen using Bitumen Feed via Air Blowing**

The objective of this project was to carry out feasibility study to make 'Zero-Pen Bitumen' from bitumen feed by air-blowing meeting specifications of M/s PT WIJAYA KARYA PERSERO TBK, Jakarta, Indonesia (WIKA)

In this project, bitumen feed which was obtained from extraction of asphalt rock was analyzed first. Analysis showed that this unconventional bitumen feed is rich in aromatics as indicated by high specific gravity and high micro-carbon residue (MCR) values and SARA analysis. The other physico-chemical properties of bitumen feed sample i.e. 11 dmm pen and nearly 72°C softening point showed that this bitumen feed is a hard material.

The Institute carried out a large number of experiments under varied experimental conditions such as air blowing temperature, air blowing rate and residence time for optimization of process conditions. The Institute successfully prepared bitumen sample having 'Zero Pen' and 125°C 'Softening Point' which was the main objective of the project. The optimized conditions for making 'Zero Pen' and 125°C 'Softening Point' bitumen were temperature 270±2°C, air blowing rate : 6.0 litres/minute/kg of feed and residence time 6 hrs and 15 min.

1.7.3 अवशिष्ट श्रेण्योन्नयन/Residue Upgradation

Upgradation of Heavy Oils by Hydroprocessing

- **Use of Slurry Phase Organic-Inorganic Fused Hybrid Catalysts for Residue Hydrocracking**

Indian refineries need to upgrade substantial quantity of residues and heavy crude oils to fulfil their demand-and-supply gap for transportation fuels. Though the use of the hydroprocessing route for residue upgradation is popular worldwide, so far in India, this process had not been used. Most of the residues were processed by either visbreaking or delayed coking reactions. Some of the residues were also processed by solvent deasphalting route. In this work, a super-critical method was used for preparation of oil-soluble catalysts. Residue hydroprocessing catalyst contains molybdenum as an active metal which is generally promoted by nickel. These metals provide the hydrogenating function to the finished catalyst. However, these metals are not so easy to dissolve into the hydrocarbon. Therefore, a method was adapted where these metals are linked with the organic modifier. These organic modifiers play an important role to dissolve the final catalyst into the hydrocarbon. Six different kinds of organic modifiers were used during the preparation of catalysts and their effect on catalytic activity was studied. Effect of concentration of the organic modifier was also studied.

The development of slurry phase hydrocracking catalysts for RIL vacuum residue was under progress. The hydroprocessing activities like hydrodesulphurization (HDS), hydrodemetallization (HDM) and conversion of residue into the lighter fractions were studied for six different catalysts. The activities were performed at the high-pressure and high-temperature Parr reactor.

- **Development of Slurry-phase Catalysts for Residue Hydrocracking**

➢ Preparation of catalysts

➢ Reaction studies in batch reactor in slurry-phase.

The principal objective of this project was the preparation of slurry phase catalysts and their hydrocracking activity test on vacuum residue.

Several catalysts were prepared by using different methods in this work.

CAT 1 was prepared by supercritical method and the catalyst had bimetallic hydrogenation functionalities. An aqueous metal solution of molybdenum was prepared by taking 150 mL of water with 14.04 gramme of tetrahydrate of ammonium hepta molybdate, and another aqueous metal solution of nickel was prepared by dissolving of 5.14 gramme of hexahydrate nickel nitrate. These two aqueous solutions were then mixed with an appropriate amount of modifier, oleic acid and then the reaction mixture was preheated at 200°C for 30 minutes in the high-pressure of 125 kg/cm^2 in a batch reactor and then the reaction mixture was treated at super-critical condition of 300-400°C and 150-300 kg/cm^2 for 10-60 minutes. In this case, the amount of oleic acid was taken in such a way that the final concentration of oleic acid was 4 molar with respect to molybdenum in the mixture solution. At these conditions, water started to behave as non-polar solvents do and the modifier was fused into the metal-inorganic framework in aqua-diffusive environment. After completion of super-critical reaction, the reaction mixture was quenched by chilled water at room temperature. The aqueous phase was then separated from organic phase where metals were fused. The organic phase was then washed with CH_2Cl_2 and dried. The prepared bimetallic-organic fused material was a solid catalyst which could easily be soluble in hydrocarbon or any organic solvents. In this particular case, the solvent was decaline. The flow diagram of the catalyst preparation method is presented in Fig. 1.

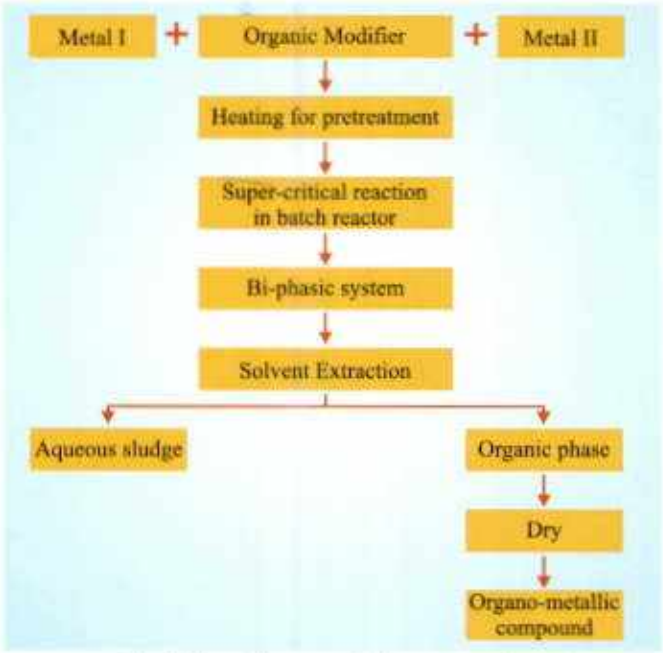


Fig.1 Flow diagram of the preparation of bi-metallic slurry-phase catalyst by super-critical method

The greatest advantage of this catalyst is that the metallic part is modified in such a way by the organic component that the final catalyst is easily soluble into the hydrocarbon. Moreover, this is a very stable complex compared with molybdenum carbonyl or cobalt naphthenate generally used as oil soluble catalysts. The thermal stability of these three catalysts has been compared in Fig. 2.

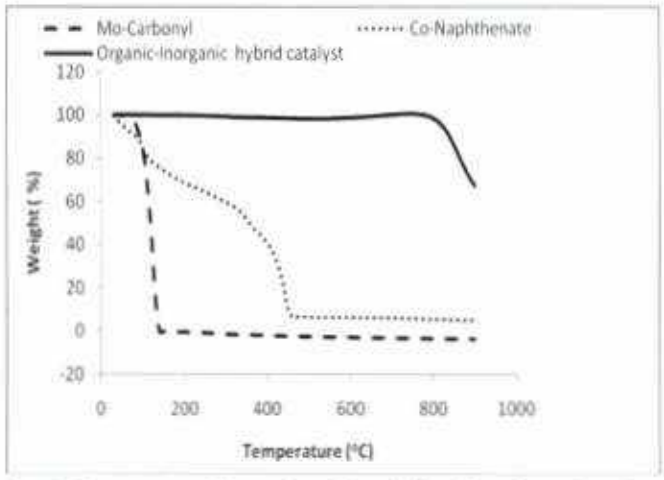


Fig. 2 Comparison of thermal stability of hybrid catalyst with others

The catalyst (CAT 2) is prepared by a procedure similar to the above. The ratio of Mo and Ni should be 0.8 to 1.5. In this particular case, palmitic acid (5.03g) was used as organic modifier. The organic phase was then washed by $CHCl_4$ and decaline was used as dispersion media.

Lauric acid (9.00g) was used as an organic modifier for the preparation of CAT 3 catalyst by keeping Mo from VIB and Ni from VIIIB reaction at super-critical condition similar to CAT 1. Diesel was used as dispersion media in this case.

Cyclohexane carboxylic acid (5.00g) was used for organic-inorganic fused material to synthesize the residue hydroprocessing catalyst CAT 4 in this particular case. In this aqueous super-critical synthesis method, the ratio of molybdenum and nickel was kept similar to CAT 1. In this case, decaline was used as dispersion media.

The catalyst (CAT 5) of this particular case was prepared by a procedure similar to the one presented in Fig. 2 and the only difference was the organic modifier which was hexadecanol (4 g) in this case. The catalyst synthesis was performed in the presence of $CHCl_4$ and LCO as dispersion media.

CAT 6 was also prepared by super-critical method and the organic modification in this case was 2-methyl 1-hexanal (12mL).

The effect of concentration of organic modifier was also studied. For this purpose, a different concentration of oleic acid was taken during the preparation of the catalyst. The super-critical method as described above was used for this preparation. The concentration of the organic modifier was varied from 1 molar to 5 molar ratio with respect to molybdenum concentration. The prepared catalysts were designated as 1M to 5M depending on the concentration of organic modifier used.

Catalyst activity test

To develop a suitable catalyst, it is obvious to screen several catalysts within the cost limits. Therefore, the process has to be chosen in such a way that it will be simple, fast and low-cost. However, the reliability of the results should not be compromised. In this regard, slurry reactor using batch autoclave is one of the best options. The operation in it is simple, fast and inexpensive. Moreover, in this process a small quantity of the catalyst is used. Fig. 3 shows a batch reactor set-up for primary screening of catalysts for hydroprocessing of the RIL residue. The following operating conditions were used for the HDT activity test.

- Weight of feed 200g
- Weight of catalyst 750rpm
- Reaction temperature 410°C
- Pressure 100kg/cm^2
- Duration of reaction 4hrs

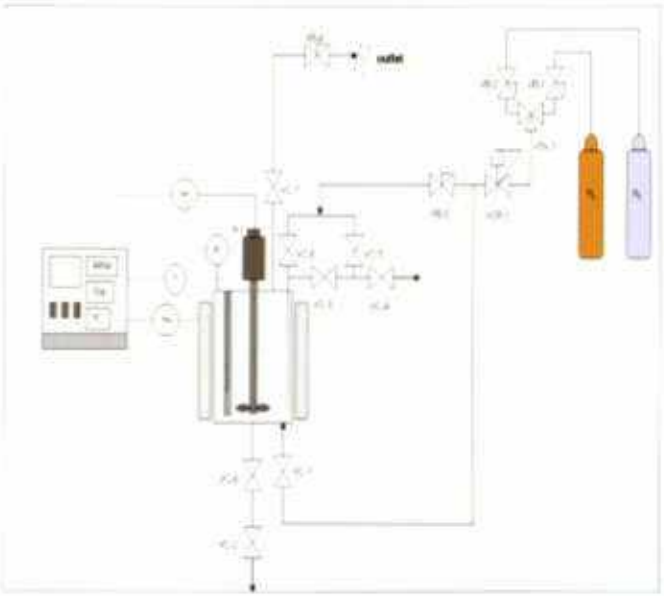


Fig. 3 Schematic flow diagram of the batch reactor

The weighted heavy crude oil or residue was taken into the reactor. The required amount of catalyst/additive was added to the feed. The reactor vessel was tightened properly and checked for any leaks. The reactor vessel was then purged two to three times with hydrogen gas so that there was no air left inside the reactor. Heating was taken from be room temperature to the required temperature at the rate of 3°C/min. Stirring (750rpm) was started when temperature reached the set point and the time was noted at this point just as done at the beginning of the reaction. After the reaction, the liquid product was separated from the carbon-like material. The liquid products were sent for analysis and the carbon-like material was cleaned by Soxhlet process.

Characteristics of feeds

Two feeds were used to study the hydroprocessing activities in the batch reactor and the feed characteristics are given below in Table 1.

Table 1: Characteristics of RIL vacuum residue (VR)

Properties of the feed used for catalyst activity test	
Property	**Value**
Density @15°C	1.0554
Kin. Viscosity@100°C, cSt	25793
Sulphur, wt%	5.85
CCR, wt%	27
C/H ratio (wt/wt)	11
Asphaltene, wt%	19.5
Ni, wppm	65
V, wppm	240

Catalyst activities

The liquid samples after reaction were separated from the solid sludge and metals, sulphur, asphaltene etc. of the liquid products were analyzed . From these analyses, HDS, HDM and asphaltene conversions were calculated and are given in Table 2. The hydrodesulphurization activity was almost similar for the all catalysts. However, the catalyst prepared by the 2-methyl 1-hexanal as solvent shows the highest HDM activity.

	CAT1	CAT2	CAT3	CAT4	CAT5	CAT6
HDS	61.33	61.92	60.88	62.21	60.26	62.19
HDM	78.89	83.25	87.44	83.93	83.69	92.87
HDAsp,	81.6	84.51	84.67	85.38	84.46	84.26

Table 2: Hydroprocessing activities of six catalysts

The effect of organic-modifier concentration on hydrotreating activities (HDS, HDM and HDAsp) was also been studied and is given in Table 3. It shows that the all the catalysts (1M to 5M) show almost equal activities.

	1M	2M	3M	4M	5M
HDS	63.51	61.51	60.82	61.33	61.67
HDM	83.0	73.6	75.25	78.9	78.13
HDAsp	88.51	87.03	82.67	81.6	86.36

Table:3 Percentage of hydrodesulphurization, hydrodemetallization and asphaltene conversion of catalysts

Hydro-cracking activities of these six catalysts and the catalysts prepared by different concentrations of oleic acid are presented in Fig 4 and Fig. 5, respectively.

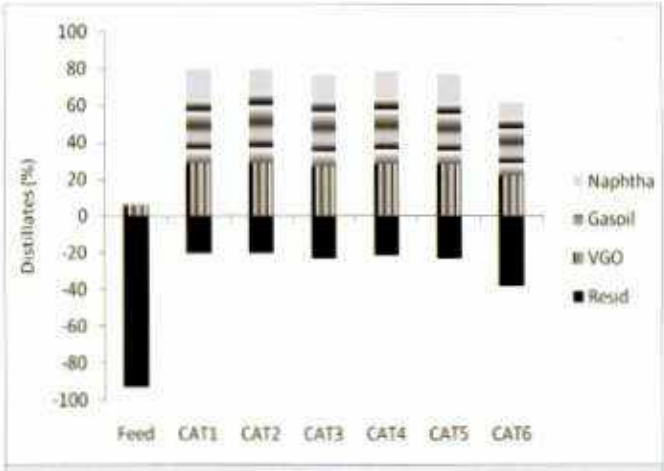


Fig. 4: Hydrocracking activity of six different catalysts

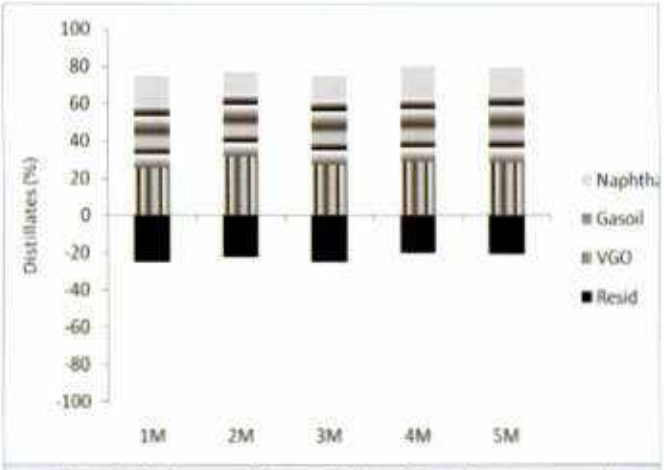


Fig. 5: Hydrocarcking activity of catalysts prepared by different concentration of oleic acid

Conclusions

The following conclusions could be drawn from this study:

1. The catalyst prepared by oleic acid as organic modifier shows good hydrocarcking activity
2. The catalyst prepared by palmitic acid also shows good hydrocracking activity
3. The catalyst prepared by the super-critical method where inorganic metals were modified by organic components has excellent thermal stability.
4. The catalyst prepared by oleic acid of concentration 4 molar shows the highest 550°C- conversion.

2

उपलब्धियाँ

Achievements

2.1 प्रकाशित शोध/ Published Research

2.1.1 जर्नलों में प्रकाशित शोध–पत्र/ Papers Published in Journals

1. TiO_2 immobilized Ru(II) polyazine complex: a visible-light active photoredox catalyst for oxidative cyanation of tertiary amines, *Pawan Kumar, Sanny Verma* and *Suman L Jain*, Journal of Materials Chemistry A **2**(13),4514-4519, April 2014
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96. Synthesis of multi-walled TiO_2 nano-tubes under weak alkaline conditions for dye-sensitized solar cells, *Vipin Amoli* and *A K Sinha*, Journal of Nanoscience and Nanotechnology, **15**(1),726-733, 2015

97. Effect of cylindricity on the tribological performance of heavily-loaded slow-speed journal bearings, *S M Muzakkir, K P Lijesh, Harish Hirani* and *G D Thakre*, Proc J MechE Part J: J Engineering Tribology, **229**(2) 178-195, 2015

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100. Photo-induced reduction of CO_2 using magnetically-separable Ru-CoPc@TiO_2@SiO_2@Fe_3O_4 catalyst under visible light irradiation, *Pawan Kumar, R K Chauhan, Bir Sain* and *Suman L Jain*, Dalton Transactions, **44**(10), 4546-4553, 2015

101. Visible light-assisted photo-catalytic reduction of CO_2 using graphene oxide-supported heteroleptic ruthenium complex, *Pawan Kumar, Amit Bansiwal, Nitin Labhsetwar* and *Suman L Jain*, Green Chemistry, **17**(3), 1605-1609, 2015

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2.1.2 पुस्तकों एवं / अथवा विवरणिकाओं में प्रकाशित अध्याय / लेख / Chapters / Articles Published in Books & / or Proceedings

- Production upgrading and analysis of bio-oils derived from lignocellulosic biomass, *Pankaj K Kanaujia*, Polysaccharides-Bioactivity and Biotechnology, Editors:Kishan Gopal Ramawat, Jean-Michel Mérillon, 1-26, Oct 2014 , Springer International Publishing Switzerland
- Preparation of feed-stocks for gasification for synthetic liquid-fuel production, *Bhavya Balagurumurthy, Rawel Singh* and *Thallda Bhaskar*, Gasification for Synthetic Fuel Production, 57-71, 2015, Fundamentals, Processes and Applications : a volume in Woodhead Publishing Series in Energy, *Edited by: R. Luque and J. Speight*, ISBN: 978-0-85709-802-3
- Methane activation and transformation over nano-catalysts, *Rajaram Bal* and *Ankur Bordoloi*, Edited by Sa, Jacinto, Fuel Production with Heterogeneous Catalysis 123-145, 2015, Published by CRCC Press Boca Raton, Fla, ISBN:978-1-4822-0371-4

Chapters Published in the Book Entitled '*Recent Advances in Thermo-Chemical Conversion of Bio-mass, 2015, Edited by : Ashok Pandey, Thallada Bhaskar, M Stöcker* and *Rajeev Sukumaran*, ISBN: 978-0-444-63289-0

Chapter 1 - Advances in Thermo-chemical Conversion of Biomass—Introduction, Pages 3-30, 2015, *Thallada Bhaskar* and *Ashok Pandey*

Chapter 2 - Feedstock Suitability for Thermo-chemical Processes, Pages 31-74, *Rupam Kataki, Rahul S Chutia, Mridusmita Mishra, Neonjyoti Bordoloi, Ruprekha Saikia* and *Thallada Bhaskar*

Chapter 4 - Catalysts for Thermo-chemical Conversion of Biomass, Pages 109-132, *Bhavya Balagurumurthy, Rawel Singh* and *Thallada Bhaskar*

Chapter 6 – Thermo-chemical Bio-refinery, Pages 157-174, *Bhavya Balagurumurthy, Rawel Singh, Priyanka Ohri, Aditya Prakash* and, *Thallada Bhaskar*

Chapter 10 – Hydro-thermal Liquefaction of Bio-mass, Pages 269-291, *Rawel Singh, Aditya Prakash, Bhavya Balagurumurthy* and *Thallada Bhaskar*

Chapter 16 – Thermo-chemical Valorization of Lignin, Pages 455-478, *Aditya Prakash, Rawel Singh, Bhavya Balagurumurthy, Thallada Bhaskar, Ajay K Arora* and *S K Puri*

2.2 प्रस्तुत की गई शोध/ Presented Research

2.2.1 सम्मेलनों / संगोष्ठियों आदि में प्रस्तुत शोध–पत्र/ Papers Presented in Conferences/ Seminars etc.

SAE 2014 World Congress, Detroit, USA, April 8-10, 2014

- Investigation of variation in real-world fuel economy of a gasoline car in two different highways traffic conditions: an Indian Scenario, *Sunil Pathak, Yograj Singh, Vineet Sood* and *S K Singal*

9th ISFL-2014, Faidabad, April 15-17, 2014

- A novel approach for utilization of bio-acetone for cleaner gasoline production, *Sandeep K Saxena, N Viswanadham* and *M O Garg*
- A single-step catalytic process for direct conversion of naphtha to higher range hydrocarbons, *Sandeep K Saxena, N Viswanadham* and *M O Garg*
- Development of new-generation bio-degradable base-stocks for marquenching oils, *Ponnekanti Nagendramma, Neeraj Atray* and *D K Adhikari*
- Role of crumb rubber in physical and rheological properties of modified bitumen, *Anand Singh, Kamal Kumar, Manoj Srivastava* and *M O Garg*
- Oxidative desulphurization of diesel with hydrogen peroxide in the presence of acid catalysts, *T V Rao, Bindu Yadav, Pooja Yadav, Rekha Chauhan, B R Nautiyal, P S Verma* and *S M Nanoti*
- Investigation of stratification stability of deoiled *Jatropha* Curcas cake based pyrolysis oil-diesel

emulsion, *Pankaj K Arya, Mukesh K Poddar, G D Thakre, D V Naik, Satish Kumar* and *T Bhaskar*

- Prospects of 2,5-Dimethlyfuran as an alternative fuel: performance characteristics evaluation on a 4s-motorcycle, *M K Shukla, Sunil Kumar Pathak, Yograj Singh, Nishan Singh* and *S K Singal*
- Halogen-free ionic liquids as novel lubricants: designed chemistry in tribological applications, *O P Khatri*

21st World Petroleum Congress, Moscow, June 15-19, 2014

- Processing of fast pyrolysis oil-derived tar fraction in fluid catalytic cracking unit, *D V Naik, Vimal Kumar, Basheshwar Prasad, Mukesh K.Poddar, K K Singh, Neeraj Atheya, D K Adhikari* and *M O Garg*
- A single step catalytic process for the direct conversion of naphtha to middle distillates, *N Viswanadham, M O Garg, Peta Sreenivasulu, Amit Sharma, Rajeev Panwar* and *Sandeep K Saxena*

Graphene Week 2014, Gothenburg, Sweden, June 23-27, 2014

- Structure and conformation heterogeneity in alkyl chains intercalated graphene oxide, *O P Khatri* and *Harshal P Mungse*

International Conference on Natural Rubber, organized by the Indian Natural Fibre Society, National Library, Kolkata, August 1-3, 2014

- Production of industrial spirit from jute fibre: A feasibility study, *D K Adhikari, Debashish Ghosh, A K Roy, Savita Kaul, Deepti Agrawal, A K Kurmi, Diptaka Dasgupta, Sunil K Suman, S N Chattopadhyay* and *S Bhowmick*

8th International Conference on Environmental Catalysis, USA, August 24-27, 2014

- Catalytic conversion of bio-mass-derived intermediates into gasoline, *Sandeep K Saxena, N Viswanadham* and *M O Garg*

21st Annual India Oil and Gas Review Summit and International Exhibition (IORS), Mumbai, September 10-11, 2014

- Improvement in pipeline flow of high-pour Mangla crude at ambient conditions by blending and addition of polymeric additives, *Manisha Sahai, Ajay Kumar, Archana Kumari* and *Sanat Kumar*

4th National Symposium on Recent Advances in Analytical Sciences and Applications (4th NSAS), University of Srinagar, September 15-17, 2014

- High-resolution NMR spectroscopic analysis of glycerides: an alternative fast tool for qualitative and quantitative analysis of non-edible seed oil, *Savita Kaul, Babita Behera, Neha Karanwal, Jitender Kumar, Piyush Gupta, Jyoti Porwal* and *Dinesh Bangwal*

DGMK-Conference on 'Selective Oxidation and Functionalization: Classical and Alternative Routes and Sources', Berlin, Germany, October 13 – 15, 2014

- Phosphorus-doped graphene as efficient catalyst for oxidative dehydrogenation of n-Butane to butadiene, *Suman L Jain, Om P Khatri* and *Praveen K Khatri*

International Conference on Emerging Trends in Biotechnology (ICETB2014), JNU, New Delhi, November 6-9, 2014

- Catalytic valorization of lignin to fine chemicals, *Aditya Prakash, Rawel Singh, Bhavya Balagurumurthy, Piyush Gupta, Raghuvir Singh* and *Thallada Bhaskar*
- Value-addition to rice straw through hydropyrolysis, *Bhavya Balagurumurthy, Vinit, Vartika Srivastava, Jitender Kumar, Rawel Singh, Aditya Prakash* and *Thallada Bhaskar*
- Effect of solvent and reaction environment on hydrothermal liquefaction of rice straw, *Rawel Singh, Kajal Chaudhary, Bhavya Balagurumurthy, Aditya Prakash* and *Thallada Bhaskar*

69th Annual Convention of Oil Technologists Association of India and International Convention on Sustainable Technologies and Futuristic Trends : Oilseed – Oil processing and Surfactants Expo 2014, Agra, November 14-16, 2014

- Studies on the synthesis and tribological performance of 1L based anti-wear additives-blended green lubricants, *Ponnekanti Nagendramma, G D Thakre, Praveen Kumar Khatri, Neeraj Atrey* and *Suman L Jain*

International Conference on Environment and Energy (ICEE-2014) at the Jawaharlal Nehru Technological University (JNTUH), Hyderabad, December 15-17, 2014

- Hetero-catalytic trans-esterification of single-cell oil: Lignocellulosic bio-mass to bio-diesel, *Sheetal Bahdhu, Jyoti Porwal, Dinesh Bangwal, Akhilesh Kurmi, Diptarka Dasgupta, Deepti Agrawal, Sunil*

Kumar Suman, Savita Kaul and *Debashish Ghosh*

- Investigating the effect of bio-fuel cetane number, density and engine operating variables on NOx emissions –a design-of-experiment approach, *Devendra Singh, K A Subramanian* and *S K Singal*
- Emission characteristics of a compression ignition engine fuelled with micro-algae and *Jatropha* bio-diesel – a comparative study, *Devendra Singh, Mohd Asif, Sethpal Singh, R Badola* and *S K Singal*

National Conference on Recent Developments in Non-Conventional Energy Systems (NCRDNCES 2014), DIT, Dehradun, December 22-23, 2014

- Sulfonated polymer-impregnated carbon composite as solid acid catalyst for selective synthesis of furfural from xylose, *Praveen Kumar Khatri, Neha Karanwal, Savita Kaul* and *Suman L Jain*
- Tribo-evaluation of newly-synthesized eco-friendly multi-functional bio-lubricant additives from histidine, *Raj Kumar Singh, Aruna Kukrety, G D Thakre* and *S S Ray*

International Conference CHEMCON 2014 organized by IIChE and Dr S S Bhatnagar University Institute of Chemical Engineering & Technology, Punjab University, Chandigarh, December 27-30, 2014

- Removal of refractive sulphur and nitrogen compounds from gas oil using solvent extraction: estimation of solubility parameters and their applications in solvent screening, *Sunil Kumar, Vimal Chandra Srivastava, S M Nanoti* and *Abhishek Kumar*
- The absorption/regeneration behaviour of CO_2 in aqueous triethylenetetramine, *Pradeeep Kumar, Durgaprasad Yedla, S Halavath* and *Subham Paul*
- Thermodynamic and kinetic evaluations of novel Ni-based catalysts for CO_2 reforming of methane, *B Neelam Naidu, K D P L N Kumar, Sachin Kumar* and *V V D N Prasad*

22nd National Symposium on Catalysis (CATSYMP) during January 7-9, 2015 at CSIR-CSMCRI, Bhavnagar

- Synthesis of orderly nanoporous alumino phosphate and zirconium phosphate materials and their catalytic applications, *Peta Srinivasulu* and *N Viswanadham*
- A novel catalytic process for utilization of bio-acetone in green transportation fuels, *Sandeep K Saxena* and *N Viswanadham*
- Development of functional hierarchical carbon-silica composite materials for catalytic applications, *Devaki Nandan, Amit Sharma, Sandeep Saran, Deependra Tripathi* and *N Viswanadham*
- A novel bi-functional catalyst for production of heavy hydrocarbons from light paraffininc feedstocks, *N Viswanadham, Amit Sharma, Peta Srinivasulu, Rajeev Panwar* and *Sandeep K Saxena*
- Preparation of Ag/WO_3 Urchin catalyst for selective oxidation of m-xylene to isophthalic acid, *Shankha S Acharyya, Shubhadeep Adak* and *Rajaram Bal*
- Cu-supported nano-hydrolactic as an efficient catalyst for levulinic acid, *Chandrashekar Pendem, Nizia Siddiqui* and *Rajaram Bal*
- Morphology-controlled TiO_2 nano-stuctures and their photo catalytic applications, *L N Sivakumar Konathala, Bipul Sarkar* and *Rajaram Bal*
- Selective oxidation of propylene to propylene oxide over CuO nano-particles supported on Tungsten oxide nano-catalyst with molecular oxygen, *Shilpi Ghosh* and *Rajaram Bal*
- Pt-CeO_2 nano-composite catalyst for room temperature chemo-selecive reduction of nitro-compounds, *Ashtha Shukla* and *Rajaram Bal*
- Ni-MgO-ZnO catalyst for carbon-di-oxide reforming of methane, *Rajib Kumar Singha* and *Rajaram Bal*
- Fabrication of $CuCr_2O_4$ spinel nano-particles: A potential catalyst for selective oxidation of cyclo-alkanes via activation of C_{sp3}-H bond, *Shankha S Acharyya, Shilpi Ghosh, Deependra Tripathi* and *Rajaram Bal*
- One-pot synthesis of phosphorous-doped mesoporous alumina for DME synthesis, *Reena Goyal, Nizia Siddiqui, Chandrashekar Pendem, Manoj Kumar* and *Ankur Bordoloi*
- Energy application of VO_4 prepared by sol-gel route, *Nikita Singhal, L N Sivakumar Konathala, Sandeep Saran* and *Umesh Kumar*
- Acid-base co-operative catalysts over modified mesoporous nitrogen-rich carbon material, *Reena Goyal, L N Sivakumar Konathala, Sandeep Saran* and *Ankur Bordoloi*
- CO_2 reforming of methane over Ni-nanocluster supported on modified Al_2O_3 *Subhasis Das, Reena*

Goyal, Sachin Kumar and *Ankur Bordoloi*

- Thermo-catalytic degradation of waste polyethylene on metal-impregnated beta zeolite to produce olefins, *Archana Kumari, Manisha Sahai, Ajay Kumar* and *Sanat Kumar*
- Hierarchical zeolites for the valorization of lignocellulosic bio-mass, *Bhavya Balagurumurthy, Rawel Singh, Ruben Ramos Velarde, Juan A Botas, David Serrano* and *Thallada Bhaskar*

The 5th Asia-Oceania conference on Green and Sustainable Chemistry, Delhi, January 15-17, 2015

- Synthesis and characterization of organiosilane directed mesoporous γ-alumina, *A K Sinha, Rohit Kumar, Deepak Verma* and *B S Rana*
- Process intensification using micro-channel reactor for gases to liquid fuel, *A K Sinha, Aditya Rai, M G Sibi, Mohit Anand* and *Saleem Akhtar Farooqui*
- Porous nickel containing silica as catalyst for hydrogenation of methyl oleate & glycerol tristearate into renewable diesel-range hydrocarbon, *A K Sinha* and *Hari Singh*
- Preparation of Ag/WO_3 urchin-like catalyst for selective oxidation of m-xylene to isophthalic acid, *Shankha S Acharyya*
- Selective oxidation of propylene to propylene oxide over CuO nano-particles supported on Tungsten oxide nano-catalyst with molecular oxygen, *Shilpi Ghosh* and *Rajaram Bal*

2nd International Conference on Nano-technology (ICNT-2015), Haldia Institute of Technology and IIChE (HRC), Haldia, February 19-22, 2015

- Preparation of silver supported on tungsten oxide nano-particles for selective oxidation of ethylbenzene, *Shilpi Ghosh, Shubhadeep Adak* and, *Rajaram Bal*
- Highly efficient Cu_2+/$CuCr_2O_4$ nano-particle catalyst for selective oxidation of ethanol, *Shankha S Acharya, Shubhadeep Adak* and *Rajaram Bal*

9th Uttarakhand State Science and Technology Congress, Vigyan Dham, Jhajra, Dehradun by UCOST, February 26-28, 2015

- Utilization of partially carboxylated pearl millet (*Bajra*) Cob, *G M Bahuguna, Raj Kumar Singh, Raghuvir Singh, Sandeep Saran* and *Y K Sharma*

5th Annual International Conference on Sustainability (SUSCON 2015), IIM, Shillong, March 11-13, 2015

- A perspective of fast pyrolysis oil processing in refinery FCC unit, *D V Naik, Vimal Kumar, B Prasad* and *Ranjan Kumar*

OMC-2015, Ravenna, Italy, March 25-27, 2015

1. Studies on optimization of key process parameters in LPG treating units, *S K Ganguly* and *L A Pellegrini*

7th European Combustion Meeting, ECM 2015, Budapest, Hungary, March 30-April 2, 2015,

2. Numerical Simulation on the effect of Cooled-EGR on NOx formation in an SI Engine, *Swapnil S Tupkari, G D Thakre, Pankaj K Arya* and *B M Shukla*

2.3 मुद्रांकित एकस्व/Patents Sealed

2.3.1 विदेशों में मुद्रांकित एकस्व/Patents Sealed Abroad

1. Process for preparation of Cu-Cr oxides for selective oxidation reactions, *Rajaram Bal, Bipul Sarkar, Shankha Shubhra Acharyya, Shilpi Ghosh, Chandrashekar Pendem* and *Jagdish Kumar*, USA, Patent No. US8697916, dt. 15.04.2014
2. A composition and process for hydraulic fluid, *A K Singh, N K Pandey* and A K Gupta, Japan, Patent No. 5535482, dt. 09.05.2014
3. Sulphonated carbon silica composite material and a process for preparation thereof, *N Viswanadham* and *Devaki Nandan*, USA, Patent No. 8,722,573, dt. 13.05.2014
4. A process for production of benzene lean gasoline by recovery of high-purity benzene from unprocessed cracked gasoline fractions containing organic peroxides, *M O Garg, S M Nanoti, B R Nautiyal, Sunil Kumar, Prasenjit Ghosh, Nisha, Pooja Yadav, Jagdish Kumar, Manish Tiwari, M R G Rao* and *N S Murthy*, USA, Patent No. 8,722,952, dt. 13.05.2014 (Jointly with Reliance Industries Limited)
5. Modified zeolite catalyst useful for conversion of paraffins, olefins and aromatics in a mixed feedstock into isoparaffins, and a process thereof, *N Viswanadham, Raviraj Kamble, Amit Sharma, Jagdish Kumar* and *B S Negi*, G Muralidhar, M O Garg, USA, Patent No. 8772560, dt. 08.07.2014
6. Process for selective hydroxylation of benzene with

molecular oxygen, *Rajaram Bal, Shankha Shubhra Acharyya, Shilpi Ghosh, Bipul Sarkar, K S Rawat* and *Chandrashekar Pendem*, USA, Patent No. 8772552, dt. 08.07.2014

7. Process for preparation of a novel catalyst useful for sweetening of sour petroleum distillates, *B B Agrawal, S N Puri, Bir Sain, B P Balodi, Bhagwati, Sunil Kumar, Anil Kumar, Pushpa Gupta, Jai Prakash, O S Tyagi, T S R Prasada Rao* and *G P Rai*, Germany, Patent No. DE10115892, dt. 16.07.2014
8. A novel multi-functional additive for aqueous lubricants, *A K Chatterjee, M R Tyagi, S S Ray, Indu Shekhar* and *Ankushi Bansal*, USA, Patent No. 8,969,268, dt. 03.03.2015

2.3.2 भारत में मुद्रांकित एकस्व/Patents Sealed in India

1. A bio-degradable lubricant composition for two-stroke engine, *Arun Kumar Singh* and *Ashok Kumar Gupta*, Patent No. 260611, dt. 13.05.2014
2. A composition of lubricating oil for two-stroke gasoline engine and a process for preparation thereof, *A K Singh, N K Pandey* and *A K Gupta*, Patent No. 261148, dt. 06.06.2014
3. A process for aromatization of light naptha using improved reforming catalyst, *B S Negi, N Viswanadham, Ashok K Saxena, J S Karir, Babu Lal, Mool Chand, V V DN Prasad, Jagdish Kumar, V K Kapoor, Y K Kucchal* and *M O Garg*, Patent No. 261691, dt. 09.07.2014
4. A composition of hydraulic fluid and process for preparation thereof, *A K Singh, N K Pandey* and *A K Gupta*, Patent No. 261841, dt. 17.07.2014
5. An improved process for production of phenol by liquid phase selective hydroxylation of benzene using hydrogen peroxide as the oxidant and vanadyl pyrophosphate as the catalyst, *A Datta, S Sakthivel* and *Jitendra Kumar Satyarthi*, Patent No. 262847, dt. 18.09.2014

2.4 आवेदित एकस्व / Patents Filed

2.4.1 विदेशों में आवेदित एकस्व/Patents Filed Abroad

1. A process for preparation of Ag-W oxide catalyst for the selective conversion of propylene to propylene oxide with molecular oxygen, *Bal Rajaram, Ghosh Shilpi, Shankha Shubhra Acharyya, Sarkar Bipul, Pendem Chandrashekar* and *Singha Rajib Kumar*, USA, Application No. 14/366244. Dt. 17.06.2014
2. A process for microwave assisted synthesis of n-methyl pyrrolidone, *Praveen Kumar Khatri, Suman Lata Jain, A K Chatterjee* and *Bir Sain*, USA, Application No. 14/477,075, dt. 04.09.2014
3. A process for preparation of nano-crystalline Pt-Ce oxide catalyst for selective hydrogenation of phenol and its derivatives, *Rajaram Bal, Bipul Sarkar, Rajib Kumar Singha, Chandrashekar Pendem, Shankha Shubhra Acharyya, Shilpi Ghosh, Reena Goyal, Subhasis Das, Ankur Bordoloi* and *L N Sivakumar Konthala*, USA, Application No. 14/489521, dt. 18.09.204
4. A process for preparation of Ni-CeMgAl$_x$O$_y$ catalyst for dry reforming of methane with carbon-di-oxide, *Ankur Bordoloi, Subhasis Das, Reena Goyal, Rajib Kumar Singha, Chandrashekar Pendem, L N Sivakumar Konathala, Rajaram Bal, V V D N Prasad, B Neelam Naidu* and *Manoj Kumar*, USA, Application No. 14/513770, dt. 14.10.2014
5. A method for increasing gas oil yield and energy efficiency in crude oil distillation, *Sunil Kumar, S M Nanoti* and *M O Garg*, USA, Application No. 14/531,276, dt. 03.11.2014
6. Nano Pt-Ce oxide catalyst for activation of methane and a process for preparation thereof, *Rajaram Bal, Rajib Kumar Singha, Bipul Sarkar, Chandrashekar Pendem, Shankha Shubhra Acharyya, Shilpi Ghosh, Ankur Bordoloi, Laxmi Narayan* and *Sivakumar Konathala*, USA, Application No. 14/592,392, dt. 08.01.2015
7. A composition for the calorimetric detection of water in hydrocarbon fuels and a process for the preparation thereof, *Praveen K Khatri, Suman L Jain, Indrajit K Ghosh, Umesh Kumar, A K Chatterjee* and *M O Garg*, USA, Application No. 14/594,873, dt. 12.01.2015
8. Halogen free ionic liquids as lubricant or lubricant additives and a process for the preparation thereof, *O P Khatri* and *Rashi*, PCT, Application No. PCT/IN2015/050022, dt. 17.03.2015

2.4.2 भारत में आवेदित एकस्व /Patents Filed in India

1. A process for aqueous polymerization using bio free-radical catalytic system, *P Padma Latha, Ankushi Bansal, Indu Shekhar, Umesh Kumar, Suman L Jain, S S*

Ray and *Alok K Chatterjee*, Application No. 938Del2014, dt. 01.04.2014

2. A process for byproduct valorization to metalworking fluids, *Savita Kaul, Jyoti Porwal, G D Thakre, Babita Behera and D K Adhikari*, Application No. 3664Del 2013, dt. 16.05.2014

3. An improved process for preparation of phosphorous containing mesoporous alumina catalyst for selective dehydration of methanol to dimethyl ether, *Ankur Bordoloi, Reena Goyal, Subhasis Das, Rajib Kumar Singha, Chandrashekar Pendem, L N Sivakumar Konthala, Rajaram Bal, Sandeep Saran* and *M O Garg*, Application No. 1364Del2014, dt. 23.05.2014

4. Development of new-generation microelectro-mechanical bio-lube base stocks for clock-like mechanisms and precision instruments, *Ponnekanti Nagendramma, G D Thakre, Neeraj Atray* and *D K Adhikari*, Appliction No. 1569Del 2014, dt. 10.06.2014

5. A process for preparation of Ni-$CeMgAl_2O_4$ catalyst for dry reforming of methane with carbon dioxide, *Ankur Bordoloi, Subhasis Das, Reena Goyal, Rajib Kumar Singha, Chandrashekar Pendem, L N Sivakumar Konathala, Rajaram Bal, V V D N Prasad, B Neelam Naidu* and *Manoj Kumar*, application No. 1843Del2014, dt. 07.07.2014

6. Faceted titania nanocrystals doped with indium oxide nanoclusters for photocatalysis, *A K Sinha, Vipin Amoli* and *M G Sibi*, Application No. 222Del2014, dt. 06.08.2014

7. Bio-degradable multi-grade crank-case oil and process for preparation thereof, *A K Singh, Raj Kumar Singh, Aruna Kukrety* and *O P Khatri*, Application No. 2387Del2014, dt. 22.08.2014

8. An improved process and catalyst containing Ni-MgO-ZnO for reforming of methane with carbon-di-oxide to produce synthesis gas, *Rajaram Bal, Rajib Kumar Singha, Chandrashekar Pendem, L N Sivakumar Konthala, Ankur Bordoloi* and *Sandeep Saran*, Application No. 2508Del2014, dt. 02.09.2014

9. An improved process to produce aromatics-rich aviation fuel along with other C_1-C_{14} hydrocarbons, *A K Sinha, Mohit Anand, Saleem Akthar Farooqui, Rakesh Kumar, R K Joshi, Rohit Kumar, Tasleem Khan* and *Parvez Alam*, Application No. 2622Del2014, dt. 12.09.2014

10. Nano Ni-CeO_2 catalyst for syngas production and preparation thereof, *Rajaram Bal, Rajib Kumar Singha, Chandrasekar Pendem, L N Sivakumar Konthala* and *Ankur Bordoloi*, Application No. 2706Del 2014, dt. 22.09.2014

11. A process for preparation of bio-diesel from algae and lipids, *Savita Kaul, Jyoti Porwal, D P Bangwal* and *D K Adhikari*, Application No. 3062DEL2014, dt. 28.10.2014

12. A process for conversion of low-polymer wax (low-molecular weight polyethylene) to waxes, base oil and grease base-stocks using organic peroxides and metal oxides, H *U Khan, Manisha Sahai, Sanat Kumar, Ajay Kumar, G D Thakre, Savita Kaul, S M Nanoti, B M Shukla, M O Garg, T P Antony* and *A K Chaturvedi*, Application No. 055Del2015, dt. 07.01.2015 (Jointly with GAIL (India) Ltd)

13. A novel process for preparation of graphene-based polyacrylamide composites and their use as aqueous lubricant additives, *S S Ray, Arvind Kumar, Babita Behera, Vineeta Panwar, Ankushi Bansal, G D Thakre* and *A K Chatterjee*, Appliaction No. 133Del 2015, dt. 15.01.2015

14. Integrated process for simultaneous removal and value-addition to the sulphur and aromatic compounds of gas oil, *Sunil Kumar, S M Nanoti, M O Garg, B R Nautiyal, Prasenjit Ghosh, Pooja Yadav* and *Nisha*, Application No. 793DEL2015, dt. 23.03.2015

15. 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*, Application No. 874Del 2015, dt. 30.03.2015

16. Preparation method of slurry-phase organic-inorganic fused hybrid catalyst used for residue hydroprocessing, *Ravindra Prajapati, Krittika Kohli, S K Maity* and *M O Garg*, Application No. 872Del2015, dt. 30.03.2015

17. An improved process for simultaneous production of benzene lean gasoline and high-purity benzene from cracked gasoline fraction, *M O Garg, Prasenjit Ghosh, Sunil Kumar, S M Nanoti* and *B R Nautiyal*, Application No. 0871DEL2015, dt. 30.03.2015

2.5 उपाधियाँ / अध्येतावृत्तियाँ इत्यादि / Degrees / Fellowships etc.

2.5.1 प्रदत्त डी.लिट्. / डी.फिल्. उपाधियाँ/ D.Litt./ D.Phil. Degrees Awarded

- Mr Bhawan Singh was awarded D.Phil. by the Academy of Scientific & Innovative Research (AcSIR), for his thesis entitled *'Development of mesoporous oxides as supports and catalysts for organic transformations'*, done under the supervision of Dr Anil K Sinha, Principal Scientist, CSIR-IIP.
- Mr Sanny Verma was awarded PhD degree on his thesis entitled *'Development of New Synthetic Methodologies for Chemical Transformations'* under the Supervision of Dr Suman Lata Jain, Senior Scientist, CSIR-IIP

Awarded by the Academy of Scientific & Innovative Research (AcSIR), CSIR-IIP

- Mr Bipul Sarkar was awarded PhD degree on his thesis entitled *'Synthesis, characterization and activity studies of differently-supported nano-clusters'* under the supervision of Dr Rajaram Bal, Scientist.
- Mr Deepak Verma was awarded PhD degree on his thesis entitled *'Development of Nano-structured Catalyst for New-Generation Fuels and Chemicals'* under the supervision of Dr Anil Kumar Sinha, Principal Scientist.
- Mr Peta Sreenivasulu was awarded PhD degree on his thesis entitled *'Facile and Green Methods for the Synthesis of Nano-porous Nano-materials for Catalytic Applications'* under the supervision of Dr N Viswanadham, Principal Scientist.

2.5.2 प्राप्त अध्येतावृत्तियाँ इत्यादि/ Fellowships Awarded

- Dr. Sandeep Saxena, Technician has been awarded Post-doctoral Fellowship by the Sutlan Qaboos University (SQU), Muscat for one year (Jan 2015 - Jan 2016)
- DAAD Research Fellowship Award to the Federal Republic of Germany to Dr O P Khatri, Sr Scientist.
- Raman Charpak Fellowship Award to Mr Pawan Kumar, PhD student by the Indo-French Centre for Promotion of Awarded Research (CEFIPRA).

2.5.3 वाचस्पति उपाधि हेतु शोध–प्रबंध/ Doctroal Theses

- Mr Devaki Nandan has submitted his doctoral thesis on 'Synthesis of Porous Carbon Composites and Metal Oxides for Catalytic Application'

2.6 सम्मान, पुरस्कार एवं अभिनंदन/ Honours, Awards & Recognitions

2.6.1 सांस्थानिक / सामूहिक पुरस्कार/ Institutional/ Group Awards

- **CSIR Technology Award for Innovation – 2014**

CSIR-IIP bagged the CSIR Technology Award for innovation – 2014 for *'A process for simultaneous production of U.S-grade gasoline and high-purity benzene from C_6 heart cut of FCC gasoline'*. The award carries a cash prize of Rs. 2.00 lakh, a plaque and a citation. The award was received on the CSIR Foundation Day, September 26, 2014, by Dr M O Garg, Director, CSIR-IIP, with the team from the CSIR-IIP and M/s Reliance, from Dr Jitender Singh, Minister of Science & Technology and Earth Sciences, *ex-offcio* Vice-President, CSIR.

Plaque of the CSIR Award

The Technology:

The CSIR-IIP developed this innovative technology for *'Simultaneous production of US-grade gasoline and high-purity benzene from FCC C_6 heart cut'* in collaboration with M/s Reliance Industries Ltd. The two partners were

CSIR Technology Award Innovation – 2014 Ceremony

granted the US patent on this technology. The BDEP of the commercial the plant based on this technology was completed by M/s Technip, NOIDA, India, and plant is scheduled for commercialization in the RIL, Jamnagar by March 2015. Due to the revision of specifications for benzene in the US gasoline to less than 0.62% under MSAT-II regulations, a great potential exists for commercialization of this technology, e.g., in North America, where there are more than 39 refineries as potential customers. Technology licensors such as Lummus, Axens & UOP have already shown interest in this technology. Before approaching CSIR-IIP, RIL approached various reputed foreign licensors. However, such technology was not available with them.

2.6.2 व्यक्तिगत पुरस्कार/Individual Awards

- **Lifetime Achievement Award For Dr M O Garg**

Dr M O Garg, Director, CSIR-IIP was announced chosen for the ICC D M Trivedi Lifetime Achievement Award for *Contribution to Indian Chemical Industry (Education & Research)* for the Year 2013 by the Indian Chemical Council, Mumbai. The function was held on Septemebr 30, 2014 at Mumbai. Mr Ananth Kumar, Hon'ble Minister for Chemicals & Fertilizers, Government of India, was the Chief Guest while Padma Vibhushan Dr Anil Kakodkar, Former Chairman, Atomic Energy Commission of India, was the Guest of Honour.

- **Recognition for Research Paper**

The paper entitled "*A perspective of fast pyrolysis oil processing in refinery FCC unit*" authored by D V Naik, Ranjan Kumar, Vimal Kumar and Bashweswar Prasad presented at the '*4th Annual International Conference on Sustainability (SUSCON-IV 2015)*' during March 11-13, 2015 at IIM, Shilong, was selected as the second best along with a cash award of Rs 15,000/-.

- डॉ दिनेश चमोला, वरिष्ठ हिन्दी अधिकारी को हिन्दी में राष्ट्रीय स्तर पर उत्कृष्ट बाल साहित्य लेखन के लिए साहित्य अकादमी का प्रतिष्ठित 'बाल साहित्य पुरस्कार–2014' दिया गया। उन्हें यह पुरस्कार उनके कविता संग्रह 'गाएं गीत ज्ञान विज्ञान के' के लिए प्रदान किया गया। बंगलूरू में 24 भारतीय भाषाओं के उत्कृष्ट बाल साहित्यकारों के साथ ही हिंदी भाषा के लिए डॉ0 दिनेश चमोला 'शैलेश' को यह सम्मान ज्ञानपीठ पुरस्कार विजेता और साहित्य अकादमी के उपाध्यक्ष प्रो. चंद्रशेखर कँवर ने प्रदान किया। डॉ0 चमोला ने इस अवसर पर 'मैं और मेरा बाल साहित्य' विषय पर उपस्थित श्रोताओं को भी संबोधित किया।

बाल साहित्य (हिंदी) के लिए डॉ चमोला को साहित्य अकादमी पुरस्कार से सम्मानित करते प्रो. चंद्रशेखर कँवर

- Dr M O Garg, Director, who was earlier chosen for the award of the ICC D M Trivedi Lifetime Achievement Award for contribution to Indian Chemical Industry (Education Research) – 2013 in recognition of his yeoman services to education, research, industry and profession by the Indian Chemical Council, received the award and citation from Mr S R Lohokare, Chairman, Technology & Energy Expert Committee –

Dr M O Garg being honoured by Mr S R Lohokare and Mr H S Karangle

ICC and from Mr H S Karangle, Director-General - ICC. Since Dr M O Garg could not be personally present to receive the award during the ICC Awards Pesentation Function held on 30th September, 2014 in Mumbai due to some exigencies, the award was presented to him during the ICC Refresher course on *'Separation Processes'* organized by the ICC on 22nd November, 2014, in Mumbai.

- हिंदी में उत्कृष्ट विज्ञान लेखन हेतु 'भारतीय विज्ञान लेखक–संघ' की उत्तराखंड शाखा द्वारा डॉ0 दिनेश चंद्र चमोला, वरिष्ठ हिंदी अधिकारी को दयानंद बृजेन्द्र स्वरूप स्नातकोत्तर महाविद्यालय, देहरादून में आयोजित एक समारोह में संघ के संस्थापक अध्यक्ष प्रो0 धीरेन्द्र शर्मा, डॉ0 ओ पी कुलश्रेष्ठ, प्राचार्य, दयानंद बृजेन्द्र स्वरूप स्नातकोत्तर महाविद्यालय, डॉ0 देवेन्द्र भसीन, प्राचार्य, दयानंद एंग्लो–वैदिक स्नातकोत्तर महाविद्यालय, तथा डॉ0 एस् फारूख, अध्यक्ष, हिमालय ड्रग कंपनी, द्वारा संयुक्त रूप से दिनांक 8 मार्च, 2015 को सम्मानित किया गया।

डॉ0 दिनेश चंद्र चमोला को सम्मानित करते हुए डॉ0 धीरेन्द्र शर्मा, डॉ0 एस् फारूख। मंच पर डॉ0 भसीन व डॉ0 कुलश्रेष्ठ

- Mrs Bhavya B Krishna, Scientist, received the **best** Poster Presentation Award at the *'International Conference on Emerging Trends in Bio-technology (ICETB-2014)'* held at the Jawaharlal Nehru University, New Delhi, during November 6-9, 2014
- An article entitled *'Value addition to rice straw through hydropyrolysis'* (Authors: Bhavya Balagurumurthy, Vinit, Vartika Srivastava, Jitendra Kumar, Rawel Singh, Aditya Prakash and Thallada Bhaskar) was also presented.
- Mr Rawel Singh received the AU-CBT Excellence Award of the year 2013 in recognition of excellent work and achievements during his doctoral studies from the Biotech Research Society of India (BRSI) at the *'International Conference on Emerging Trends in Bio-technology (ICETB-2014)'* held at the Jawaharlal Nehru University, New Delhi, during November 6-9, 2014
- Dr Thallada Bhaskar, Sr Scientist, was chosen for various a positions, viz.:
  - Member, Board of Governors, Biotech Research Society of India (2013-2015);
  - Member, Editorial board member, Bioresource Technology, Elsevier Inc.
  - Member, Editorial Board Member, Heliyon, Elsevier Inc (Open access journal).

- **नगर राजभाषा कार्यान्वयन समिति, देहरादून प्रतियोगिता में सम्मान**

नगर राजभाषा कार्यान्वयन समिति, देहरादून की ओर से भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद, देहरादून द्वारा आयोजित निबंध प्रतियोगिता में संस्थान के डॉ0 राजकुमार सिंह, वैज्ञानिक ने द्वितीय स्थान प्राप्त किया।

2.7 संपन्न समझौता–ज्ञापन / सहयोग–ज्ञापन / करार / MoU's/ MoC's / Agreements Signed

2.7.1 भारतीय संस्थाओं के साथ/With Indian Concerns

- Non-disclosure agreement with M/s Haldia Petrochemicals Limited, Kolkata *to study C_4 recovery from cracked LPG of IOC Haldia, value-addition to CBFS and re-run column bottom, toluene recovery from hydrogenated pyrolysis gasoline, value-addition for C_9 stream, alkylation of toluene with methanol to produce P-xylene, styrene recovery from raw pyrolysis gasoline, and value-addition of C_5 streams*
- MoU with the Indian Institute of Technology (Banars Hindu University), Varanasi for academic collaboration
- M/s Param Global Energy, Mumbai on *process for extraction and quality improvement of wax from petroleum tank bottom sludge.*
- Non-disclosure Agreement with M/s Technip India Limited, NOIDA for Process Technology including catalysts *for conversion of waste plastics to value-added products e.g. gasoline, diesel and aromatics.*
- With the University Institute of Chemical Technology, Jalgaon for *academic collaboration.*

- Non-disclosure Agreement with M/s Daimler India Commercial Vehicles Pvt. Ltd., Kancheepuram, Tamil Nadu for *Engine testing services.*
- Non-disclosure Agreement with M/s Daya Lubricants Pvt. Ltd., Mumbai for *re-refining of used automotive and industrial oils through solvent extraction.*
- AoD, IOCL, Digboi, Assam and CHT, NOIDA for *Study to examination of the possibility of production of naphthenic base oil and paraffin wax from waxy distillate streams.*
- MoU with Oil and Natural Gas Corporation Limited (ONGC), Energy Centre, Delhi *'Thermo-chemical hydrogen generation through partially open S-Loop S-I process involving H_2S incineration: part i. experimental study of bunsen reaction and hi decomposition'.*
- Non-disclosure Agreement with M/s Xcelris Labs Limited, Ahmedabad for *'Genomic and proteomic analysis of microbial strains'.*
- Non-disclosure Agreement with M/s Rizol Petro Product Private Limited, Bahadurgarh, Haryana for *'Eco-friendly sprayable girth gear lubricating grease'.*
- Non-disclosure Agreement with Carborundum Universal Ltd, Chennai for *'Technology and process for bio-degradable cutting oil/fluid (neat oil)'.*
- MoC with M/s Technip India Limited, NOIDA *for collaboration.*
- Non-disclosure Agreement with M/s GAIL India Ltd and M/s Technip India Ltd. for *'Waste plastics-to-value-added products'.*
- MoU with the Cental University of Jharkhand for academic collaboration.
- Non-disclosure Agreement with M/s GE India Technology Centre Pvt. Ltd. Bagalore for *'Processing crude oil either neat and or in blends reliably and in the process creating value to hydrocarbon as produced'.*
- MoU with the Indian Institute of Tehnology (IIT), Roorkee for *AISRF research services agreement.*
- MoU with the Manav Rachna International University, Faridabad for *academic collaboration.*
- MoU with the Indian Institute of Technology, Mandi for *academic collaboration.*
- MoU with the Bharat Petroleum Corporation Limited, Mumbai for *'Development and commercialization of new ammonical water soluble fixed bed sweetening catalyst for Gasoline /Kero/ATF'.*

2.7.2 विदेशी संस्थाओं के साथ / With Foreign Concerns

- With M/s SABIC Petrochemicals BV, The Netherlands *for technical services*
- With the Cranfield University, UK *for academic collaboration*
- MoU with the Indian-Ukrainian Project Agreement for collaboration with the National Academy of Sciences, Ukraine.
- MoU with the SABIC and CSIR-(IIP-NCL-IICT) *for Research and development of chemicals & petrochmicals.*

3

मानव संसाधन विकास

Human Resource Development

3.1 तेल उद्योग एवं तत्संबंधी क्षेत्रों के कार्मिकों को प्रशिक्षण/Training the Personnel from the Oil Industry & Related Fields

As a part of its mandate, The CSIR-IIP imparts training to the personnel from the oil industry & related fields like the automobile industry and the transport sector etc.

3.1.1 'पेट्रोलियम परिष्करण प्रौद्योगिकी' पर आयोजित कार्यक्रम /Programmes on *'Petroleum Refining Technology'*

- Programme for the officers of the IOCL, New Delhi, May 19-30, 2014
- Programme for the Engineers of the IOCL, New Delhi , June 30 – July 11, 2014
- Programme for the chemical engineers of the IOCL, New Delhi, August 11- September 26, 2014
- Training Programme for the officers of the IOCL, New Delhi, November 10-21, 2014
- Programme for the officers of the IOCL, New Delhi, February 9-20, 2015

Faculty & trainees during the training programme, May 19-30, 2014

Faculty & trainees during the training programme, August 11- September 26, 2014

3.1.2 अन्य कार्यक्रम/Other Programmes

- Training Programme on *'Analytical Procedures for Numaligarh Wax Plant'*, June 26-27, 2014
- Programme on *'Vehicular Pollution'* for the Officers of the MRTH, New Delhi, August 4-8, 2014
- Programme on 'Operation and Maintenance of CFR Engines', BPCL,Mumbai, September 1-6, 2014
- Workshop-cum-Training Programme on *'Vehicular Emissions and Control'* for Officers of the Ministry of Road Transport & Highways, New Delhi, October 27-31, 2014

Faculty & trainees of the programme during October 27-31, 2014

- Training Programme on *'Operation and Maintenance of CFR Engines'* for the executives of different refineries, December 15-26, 2014
- Programme on *'Analysis of Petroleum and Petroleum Products'* for the QC officers/chemists of different refineries, January 19-31, 2015
- Workshop-cum-Training Programme on *'Vehicular Pollution'* for the officers of the MRTH, New Delhi, February 2-6, 2015
- Programme on *'Operation & Maintenance of CFR Engines'* for the officers of the HPCL, Mumbai, February 16-21, 2015
- Programme on *'Heat Exchanger Design & Troubleshooting'* for the Petroleum & Petro-chemical Industry, February 23-25, 2015
- Programme on *'GC-Mass'* for the officers of M/s Bharat Petroleum Corporation Ltd., NOIDA, March 23-25, 2015

3.2 कर्मचारियों के लिए मानव संसाधन विकास कार्यक्रम/HRD Programmes for the Employees

3.2.1 मानव संसाधन विकास केंद्र (सीएसआइआर), गाजियाबाद द्वारा आयोजित कार्यक्रम/ Programmes Organized by the HRDC (CSIR), Ghaziabad

- Mr D P Bangwal and Mr R C Saxena, Sr Technical Officers, *'Training Programme on Crafting Effective S&T Communication'*, May 26-28, 2014
- Mr Prashant Bhardwaj and Mr Prashant Bahuguna, Assistants, *'Induction Training Programme for*

Assistants (General/Finance & Accounts/ Stores & Purchase, Grade-I), recruited under the Combined Administrative Services Examination (CASE) -2013', June 23 to July 25, 2014

- Mr Jitendra Kumar and Mr Appala Naidu Chokkapu, TA's, *'Orientation Training Programme for Technical Group III Personnel'*, July 14-18, 2014
- Mr Suresh Pant, SPO, *'Training Programme on Emerging Trends in Materials Management for CoSPs & SPOs'*, September 2-3, 2014
- Mr Hari Chand Singh & Satish Kumar, Tech. Officers, *'Training Programme on Managerial Effectiveness for Technical Officers'*, November 10-12, 2014
- Dr S K Sharma, Chief Scientist, *'Workshop on Science Dissemination & Brand Building for Science Correspondence'*, November 13-15, 2014
- Mr A C Gairola, F&AO, *'Training-cum-Interaction Programme for COFA's/ FAO's'*, February, 12-13 2015
- Mr Mukesh Gairola, Section Officer, *'Refresher Training Programme for Section Officers (General)'*, February 16-18, 2015
- Mr Manoj Kumar, Technical Assistant, *'Orientation Training Programme for Technical Group III Personnel'*, March 23-27, 2015

3.2.2 विभिन्न संगठनों / संस्थाओं आदि द्वारा आयोजित कार्यक्रमों में उपस्थिति /Attendance in Programmes Organized by Different Organizations /Institutions etc.

- Mr K D P L Phani Kumar and Akhilesh Kumar Kurmi, *'9th Summer School Programme on Petroleum Refining & Petrochemicals'*, IIPM Gurgaon, organized by the Petrotech Society of India and the IOCL, June 2-6, 2014
- Mr Rawel Singh and Mr Aditya Prakash, Research Fellows, *'2nd Sahyog Summer School'*, organized by the Department of Energy, Tezpur University, Tezpur, July 20-26, 2014
- Workshop on *'Awareness Against Drug Abuse'* by Narcotics Control Bureau, Dehradun, July 31, 2014
- *Workshop on Insurance'* by M/s Max Life Insurance, August 1, 2014
- Mr A C Gairola, F&AO, *'Training Programme for Finance Cadre Officers'*, NIFM, Faridabad, August 4-8, 2014.
- Mr Pankaj Arya, Scientist & Mr R C Saxena, Sr Tech. Officer, *'Training Course on Safety Aspects in the Research Applications of Ionising Radiation-'RA-44'* at the BARC, Mumbai, oraganized by the Indian Association for Radiation Protection, December 1-9, 2014
- Mr L S Negi, CoA, Mr C S Bisht, Section Officer, Mrs Sandhya Jain, TA and Mr Mukesh Sharma, *'AEE Training programme on Preventive Vigilance in Works & Services'*, organized by CSIR-HRDC, CSIR-IMT, Chandigarh, February 23- 24, 2015

3.3 संभाषण–गोष्ठियाँ/Colloquia

- Mr Bhawan Singh, SRF, *'Development of mesoporous oxides as supports and catalysts for organic transformations'*, May 20, 2014
- Mr Sanny Verma, Research Scholar, CSIR-IIP, *'Development of new synthetic methodologies for chemical transformations'*, August 20, 2014
- Prof Sambasivarao Kotha, FNASc, FASc, FRSC, Department of Chemistry, Indian Institute of Technology-Bombay, Mumbai, *'Olefin metathesis – a big deal reaction'*, August 20, 2014
- Mr Devaki Nandan, Research Scholar, CSIR-IIP, *'Synthesis of porous carbon composites and metal oxides for catalytic applications'*, September 24, 2014
- Dr M Ali Haider, Ph.D., Assistant Professor, Department of Chemical Engineering, Indian Institute of Technology-Delhi, *'Synthesis, performance and characterization of electrocatalytic materials for solid oxide fuel cell cathode'*, September 29, 2014
- Mr Rawel Singh, Research Scholar, CSIR-IIP, *'Functional and valuable chemicals from second- and third-generation bio-mass: exploitation of hydrothermal liquefaction'*, October 10, 2014
- Ms Ankushi Bansal, Research Scholar, CSIR-IIP, *'Development of a novel initiator and catalysts for living free radical polymerisation'*, October 10, 2014
- Mrs. Bhavya B Krishna, Scientist, CSIR-IIP, *'Slow- and hydro-pyrolysis approaches for production of bio-oil and bio-char'*, October 20, 2014
- Mr Shankha Subhra Acharya, Senior Research Fellow, CSIR-IIP, *'Preparation of copper-chromium oxide nano-particle catalysts & their catalytic activities in oxidation reactions'*, November 21, 2014.

- Ms Shilpi Ghosh, Senior Research Fellow, CSIR-IIP, *'Development of silver-tungsten based nano-structures and their catalytic applications in oxidation reactions'*, November 24, 2014
- Dr Arjun Tuteja, PhD (Mech. Engg.), University of Wisconsin, Madison, USA, Ex-General Motors, *'A Short Introduction to Turbocharging of IC Engines'*, March 2, 2015

3.4 विदशों में प्रतिनियुक्तियाँ/ Deputations Abroad

- Dr Y K Shrama, Chief Scientist, Member of CSIR delegation to participate in the First Joint KISR-CSIR Meeting for holding discussions for evolving joint collaborative projects etc., Kuwait, April 15-16, 2014
- Dr Pankaj Kumar Kannaujia, Scientist and Mr Deependra Tripathi, Technical Assistant, visited UK in connection with a training on High Resolution Mass Spectrometer, May 5-16, 2014
- Dr G D Thakre, Scientist, visited the Northwestern University, Evanston, Illinois, USA and the University of Akron, Ohio, USA under the IUSSTF sponsored project *'30-JC-2012-Elastohydrodynamic Lubrication Studies'* (jointly with IIT-Roorkee), June 5-July 20, 2014
- Dr M O Garg, Director and Mr D V Naik, Scientist, visited Russia to attend the *'21 World Petroleum Congress'* at Moscow and to present papers, June 15-19, 2014
- Mr Devaki Nandan, SRF, visited Australia in conncection under an Australia-India Strategic Research Fund (AISRF)- CSIR-IIP joint project, July 7-August 3, 2014.
- Dr Thallada Bhaskar, Principal Scientist, visited Durban, South Africa, for delivering a lecture at the *'5th IUPAC International Conference on Green Chemistry'* and for participation in UK-India-Brazil-Africa RSC workshop on *'Green chemistry for Sustainable Production of Bio-fuels'*, August 17-22, 2014.
- Mr Sunil Kumar, Scientist, visited the University of Melbourne, Australia, to participate in a workshop under a project funded by the Australia-India Strategic Research Fund (AISRF), entitled *'Mini DME: A custom-design solution to bring stranded gas to the energy markets'*, August 31-September 13, 2014.
- Dr Anshu Nanoti, Senior Principal Scientist visited the University of Melbourne, Australia for project review meetings in connection with a collaborative project entitled *'Renewable Energy from Bio-gas Technology Development'* under the Australia-India Strategic Research Fund (AISRF), August 31-September 5, 2014.
- Dr M O Garg, Director, and Dr S M Nanoti, Chief Scientist, visited Germany and The Netherlands to attend the *'20th International Solvent Extraction Conference-2014'* (ISEC 2014) at Würzburg and attended a meeting at the SABIC Petrochemicals, Geleen, The Netherlands, September 7-12, 2014.
- Mr Prasenjit Ghosh, Scientist, visited The Netherlands to attend a meeting with the SABIC Petrochemicals, Geleen, September 11-12, 2014.
- Dr M O Garg, Director, led the Indian delegation of the Bureau of Indian Standards (BIS), Govt. of India at Fortaleza, Brazil, to attend the *'28th Meeting of the ISO/TC 28-Petroleum Products and Lubricants'*, September 29 - October 2, 2014.
- Mr Rashi Gusain visited Kyoto University, Japan for technical discussions and to conduct experiments under the Institute's on-going Indo-Japanese bilateral project entitled *'Graphene thin-film self-assembled on silicon: chemical, structural and tribological evolution'*, October 6 - November 6, 2014.
- Dr O P Khatri, Scientist, visited Germany under a DAAD Scholarship on a research project awarded by the DAAD, and entitled *'Nano-tribology of halogen-free ionic liquids on steel surface'* with Prof. Roland Bennewitz, Head of Nano-tribology, INM-Leibniz Institut für neue Materialien, Saarbrucken, Germany, October 12 – December 13, 2014.
- Dr Suman Lata Jain, Senior Scientist, visited Germany to present a research paper at the DGMK Conference entitled *'Selective oxidation and functionalization: classical and alternative routes and sources'*, Berlin, Germany, October 13-15, 2014.
- Dr M O Garg, Director, and Dr Anil Sinha, Principal Scientist, participated in the discussion on Australia-India Strategic Research Fund (AISRF) project entitled *'Functionalized hierarchical nano-composites for*

synthetic fuels production', CSIRO, Melbourne, Australia, November 16-21, 2014

- Dr Rajaram Bal, Scientist, visited CNR-Instituto per lo Studio Materiali Nanostrutturati-Sezione di Palermo (CNR-ISMN), Italy, for discussions on the on-going CNR-CSIR Programme of Co-operation (2012-2014), December 12-27, 2014. The Project involved is entitled, *'Catalytic partial oxidation of methane to syngas over Ni-based nano-catalysts'*.
- Mr Pawan Kumar, SRF, remained on a visit to France to work with Prof Rabah Boukherroub, *Groupe NanoBiointerfaces*, Institut de Recherche Interdisciplinaire (IRI), Lille, France, under the Raman-Charpak Fellowship 2014, December 17, 2014 - June 16, 2015. He will be engaged in the project on *'Photo-catalytic reduction of carbon-di-oxide to fuels and chemicals'*.
- Dr M O Garg, Director, as a visiting scientist participant of the *'Special Lecture Tour Programme'* under the Japan-India Co-operative Science Programme between the DST and the JSPS, Japan, January 7-13, 2015
- Dr A K Sinha, Principal Scientist, visited the National Chung-Cheng University, Taiwan under the India-Taiwan S&T Co-operation project entitled *'Super magnetic porous iron-oxide nano-structures for magnetically separable catalysts and MRI contrast agents'*, Taiwan, February 11-16, 2015
- Dr Thallada Bhaskar, Principal Scientist, visited the Fraunhofer Institute for Environmental, Safety and Energy Technology (UMISCHIT), Sulzbach-Rosenberg, Germany, under an Indo-German (DST-DAAD) project, March 1-7, 2015
- Mr Rawel Singh, SRF, visited the Fraunhofer Institute for Environmental, Safety and Energy Technology (UMISCHIT), Sulzbach-Rosenberg, Germany, under an Indo-German (DST-DAAD) project, March -7, 2015
- Dr O P Khatri, Senior Scientist, visited the Kyoto University, Japan, under the on-going Indo-Japanese bilateral project entitled *'Graphene thin film self assembled on silicon: chemical, structural and tribological evolution'*, Japan, March 19 -April 7, 2015
- Dr Anil K Sinha, Principal Scientist, visited the Coal Energy Technology Institute (CETI, NASU), Kieve, Ukraine for technical discussions under the on-going Indo-Ukraine collaborative research project entitled *'Research in the new processes of motor fuel production from wastes; hydrogen and synthesis gas generation from solid bio-mass etc.'*, March 28 - April 6, 2015

4

अनुसंधान-संबंधी गतिविधियाँ : प्रारंभ की गईं, चालू एवं संपन्न हो चुकीं

Research Activities : Initiated, On-going & Completed

4.1 प्रारंभ की गई परियोजनाएँ / Projects Initiated

4.1.1 प्रायोजित/Sponsored

1. Technology development for simultaneous production of pure benzene and us grade gasoline from FCC C6 heart cut (deisohexaniser side cut)
2. process simulation and design of soaker drum internals for revamp of soaker visbreaking unit at IOCL-Haldia refinery
3. feasibility study for making zero pen bitumen using bitumen feed via air blowing
4. Mibk dewaxing / deoiling studies on PWD (370-482 AET cut) & foots oil (dewaxed oil) for Digboi refinery
5. Delayed coking study on vacuum residue (VR) & FCC slurry oil for Essar refinery
6. Study to examine the possibility of production of naphthenic base oil and paraffin wax from waxy distillate streams in petroleum refinery
7. Stage-i basic feasibility study for mibk deoiling of HVGO and VR streams for the production of microcrystalline waxes at Numaligarh refinery
8. Hydroprocessing of residues
9. study for carrying out the slurry viscosity of PWD stream with mibk solvent at four different operating temperature for Digboi refinery of IOC (AOD)
10. Metal nano-clusters embaded hetroatom dopped carbon nano-tubes for catalytic transformation
11. Hydrogenation activity of pd/c catalyst
12. Setting up of 10 TDP pilot plant for conversion of waste plastics to value added hydrocarbons (phase-1)
13. Establishing proof of concept for processing straight run naphtha for recovery of naphthenes and aromatics
14. Post combustion CO_2 capture : development of solvent system for conventional and phase change absorption process
15. Bench scale study for conversion of low polymer wax into waxes and greases
16. Consultancy with respect to different processes for the production of petrochemical products from hydrocarbon feedstocks
17. Feasibility studies for production substitute for wax special 6 from indigenous sources (phase-i)
18. Development of a VSA technology for simultaneous production of high purity CO_2 and H_2 from the H_2PSA tail gas of a petroleum refinery
19. Thermo-chemical hydrogen generation through partially open-loop S-I process involving H_2S incineration : part I, experimental study of bunsen reaction and hi decomposition
20. Advanced polymer synthesis: India-Korea research internship programme: visit of Korean student to India
21. Utilization of C4 refinery stream to produce high value chemicals
22. "Pyrtreatindia" : alternative fuels for a decentralized power generation in India
23. depolymerisation of lignin
24. Graphene thin film self-assembled on silicon: structural and tribological evolution
25. Development of corrosion monitoring technique for hydrocarbon systems using then layer activation technique (TLA)
26. Wear rate measurement in automobile gear box using a twin disk tribo-tester through thin layer activation technique (TLA)
27. Analysis of fire resistant hydraulic fluid (FRHF)
28. Comparative testing of tribological properties of Russian and Indian main gear box lubricating oil
29. Evaluation of hydraulic oil IML hydrol 68 for FZG test
30. Study on drive train losses and fuel efficiency of passenger cars and SUVS
31. Study on optimization of 3 wheelers (CNG) for emissions
32. Study on optimization of 3 wheelers (CNG) for emissions
33. Study on parametric CNG kit optimization for emissions
34. Study on CNG 3 wheeler kit optimization for lower emissions
35. Study on CNG 3 wheeler kit optimization for lower emissions
36. Study for used emulsion oil testing of fire resistant hydraulic fluid

37. Development of improved PNG domestic cooking burner
38. To study the deposit characteristics of three nos. of four-stroke, two wheeler petrol engines components
39. Study of running in performance and endurance of genset engines 4725 and 41035
40. Gear teeth surface distress rating of Tata 3118 truck's gear box G750
41. Performance and emission of Euro IV, CNG engine on transient dynamometer test facility
42. Material compatibility and emission performance measurement with ethanol blended gasoline (E20)
43. Transient test / analysis
44. Operation of Fuel Testing Laboratory at Noida (2014-2015)
45. Development of graphene-metal oxide nano-composites as a potential candidate for photovoltic applications
46. Development of rubber extender oil from clarified slurry oil of Reliance Industries Ltd.
47. Studies on naphtyl fuel from DRDL as per GOST 12308-89
48. Scientific study of operating product losses in SKO/HSD incurred by SKO dealers / HSD retail outlets
49. Short evaluation studies on CB-NO/3 oil & gas block crude oil from Essar Oil Ltd.
50. Studies of physico-chemical hydraulic oils from Raj Petro Specialties Pvt. Ltd., Mumbai
51. Short evaluation studies on crude oil sample from Hindustan Exploration Company Ltd., Chennai
52. Short evaluation studies of Karan Nagar crude oil from ONGC Ahmadabad
53. Testing of alpha olefin C20+

4.1.2 संस्थानगत/In-house

1. Development of slurry phase catalyst for residue upgradation
2. Deactivation study of hydro processing catalysts
3. Technology development for making on grade aromatic oil of desired low PCA content from lube distillate
4. Development of a process for the synthesis of 3-methylpentane-1,5-diol (MPD)
5. Characterization of bio-oil by NMR and GC-MS
6. Valorization of lignin to value added chemicals
7. Studies on the development of deep eutectic solvents (DESS) as bio-lubes/bioadditives
8. Ionic liquids / immobilized ionic liquids as recyclable catalysts for the alkylation of aromatic compounds
9. Isolation, purification and characterization of photosensitive protein from anoxygenic photosynthetic bacteria
10. Bio-degradability test for in-house and outside lubricant samples as per ASTM D5864
11. Study of ethane as fuel for compression ignition engine
12. Study and development of temperature monitoring unit for in-house R&D works & processes
13. Combustion analysis of SIengine (Euro IV) using alternative fuels like LPG and DME and comparison with gasoline
14. Optimization of analytical methods for chemical characterization of biomass pyrolysis oil
15. Replenishment of store-chemicals, glasswares etc. (revised 2014-15)
16. Purchase / procurement of it equipments (computer, printer, scanner, network components etc.) and AMC of PC, printer etc. and payment of internet lease line (revised 2014-15)
17. To provide mechanical services to the Institute (2014-2015)
18. Technical and non-technical photography (2013-14)
19. Instrumentation division : to give instrumentation support to the Institute

4.1.3 XII पंचयो / संजाल परियोजनाएँ/XII FYP / Network Projects

- Technologies and products for solar energy utilization through networks (TAPSUN) : novel approaches for solar energy conversion

4.2 चालू परियोजनाएँ/On-going Projects

4.2.1 प्रायोजित/Sponsored

1. Renewable energy from biogas technology development
2. Desulfurization of residual fuel oil (RFO) using solvent extraction route
3. Technology development for simultaneous production of pure benzene and us grade gasoline from FCC C6 heart cut (deisohexaniser side cut)
4. Technology development for adsorbed natural gas
5. Development and commercialization of new ammonical water soluble fixed bed sweetening catalyst
6. Crude preheat maximisation study for CDU-I & II
7. Generation of technology information package (TIP) for the project simultaneous production of pure benzene and us grade gasoline from FCC C6 heart cut (deisohexaniser side cut)
8. Feasibility study for value addition to low polymer wax
9. Simultaneous production of pure benzene and us grade gasoline from FCC C6 heart cut : support during development of the BDEP
10. Process engineering design package for solvent deoiling unit at NRL
11. Process simulation and design of soaker drum internals for visbreaking unit at IOCL-Mathura Refinery
12. Process simulation and design of soaker drum internals for revamp of soaker visbreaking unit at IOCL-Haldia refinery
13. Feasibility study for making zero pen bitumen using bitumen feed via air blowing
14. Mibk dewaxing / deoiling studies on PWD (370-482 AET cut) & foots oil (dewaxed oil) for Digboi refinery
15. Delayed coking study on vacuum residue (VR) & FCC slurry oil for Essar refinery
16. Study to examine the possibility of production of naphthenic base oil and paraffin wax from waxy distillate streams in petroleum refinery
17. Stage-I basic feasibility study for MIBK deoiling of HVGO and VR streams for the production of microcrystalline waxes at Numaligarh refinery
18. Hydroprocessing of residues
19. Study for carrying out the slurry viscosity of PWD stream with mibk solvent at four different operating temperature for Digboi refinery of IOC (AOD)
20. Production of second and third generation biofuels (biomass-to-liquid)
21. Dye sensitized solar cell (DSSC)/ quantum dot dye sensitized solar cell
22. Hydropyrolysis of lignocellulosic biomass to value added hydrocarbons
23. Development of catalyst for the production of *syn-gas* from CO_2 and methane
24. Research of the new process of motor fuel production from waste. Hydrogen and synthesis gas generation from solid biomass and domestic wastes. Conversion of biomass-derived gases (*syn-gas*) to second & third generation liquid biofuel using nanocatalysts
25. Pilot plant run for hydrogenolysis of glycerol to 1,2-propanediol
26. Revamp of existing naphtha hydrotreater to process vegetable oil for renewable aviation fuel production
27. Mini-DME : a custom designed solution to bring stranded gas to the energy market
28. Metal nano-clusters embaded hetroatom dopped carbon nano-tubes for catalytic transformation
29. Hydrogenation activity of pd/c catalyst
30. Setting up of 10 TDP pilot plant for conversion of waste plastics to value added hydrocarbons (phase-1)
31. Establishing proof of concept for processing straight run naphtha for recovery of naphthenes and aromatics
32. Post combustion CO_2 capture : development of solvent system for conventional and phase change absorption process
33. Bench scale study for conversion of low polymer wax into waxes and greases
34. Consultancy with respect to different processes for the production of petrochemical products from hydrocarbon feedstocks

35. Feasibility studies for production substitute for wax special 6 from indigenous sources (phase-i)
36. Development of a VSA technology for simultaneous production of high purity CO_2 and H_2 from the H_2PSA tail gas of a petroleum refinery
37. Thermo-chemical hydrogen generation through partially open-loop S-I process involving H_2S incineration : part i, experimental study of bunsen reaction and hi decomposition
38. Photochemical reduction of CO_2 via visible light promoted homogeneous redox catalysis
39. Advanced polymer synthesis :: India-Korea research internship programme : visit of Korean student to India
40. Utilization of C4 refinery stream to produce high value chemicals
41. "Pyrtreatindia" : alternative fuels for a decentralized power generation in India
42. Depolymerisation of lignin
43. Graphene thin film self-assembled on silicon: structural and tribological evolution
44. Development of corrosion monitoring technique for hydrocarbon systems using then layer activation technique (TLA)
45. Indo-us joint center on elastohydrodynamic lubrication studies
46. Wear rate measurement in automobile gear box using a twin disk tribo tester through thin layer activation technique (TLA)
47. Analysis of fire resistant hydraulic fluid (FRHF)
48. Comparative testing of tribological properties of Russian and Indian main gear box lubricating oil
49. Evaluation of hydraulic oil IML hydrol 68 for FZG test
50. Study on drive train losses and fuel efficiency of passenger cars and SUVS
51. Study on optimization of 3 wheelers (CNG) for emissions
52. Study on optimization of 3 wheelers (CNG) for emissions
53. Study on parametric CNG kit optimization for emissions
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55. Study on CNG 3 wheeler kit optimization for lower emissions
56. Study for used emulsion oil testing of fire resistant hydraulic fluid
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58. To study the deposit characteristics of three nos. of four-stroke, two wheeler petrol engines components
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61. Performance and emission of euro iv, CNG engine on transient dynamometer test facility
62. Material compatibility and emission performance measurement with ethanol blended gasoline (E20)
63. Transient test / analysis
64. Operation of Fuel Testing Laboratory at NOIDA (2014-2015)
65. Development of graphene-metal oxide nano-composites as a potential candidate for photovoltic applications
66. Development of rubber extender oil from clarified slurry oil of Reliance Industries Ltd.
67. Studies on naphtyl fuel from DRDL as per GOST 12308-89
68. Scientific study of operating product losses in SKO/HSD incurred by SKO dealers / HSD retail outlets
69. Short evaluation studies on CB-NO/3 oil & gas block crude oil from Essar Oil Ltd.
70. Studies of physico-chemical hydraulic oils from Raj Petro Specialties Pvt. Ltd., Mumbai
71. Short evaluation studies on crude oil sample from Hindustan exploration company ltd., Chennai
72. Short evaluation studies of Karan Nagar crude oil from ONGC Ahmadabad
73. Testing of alpha olefin C20+

4.2.2 संस्थानगत/In-house

1. Extraction, characterization, upgradation and rheological behavior of bitumen extracted from Canadian tar sands
2. Generation of design data and assessment of catalyst deactivation and life cycle for setting up of pilot plant for conversion of waste plastics to gasoline, diesel and aromatics
3. Upgradation of heavy oils by hydroprocessing
4. studies on relationship between feed stock composition & mesophase / semicoke formation and their surface morphology
5. Feasibility study to make viscosity grade (VG) bitumen by blending of crumb rubber / petroleum pitch or combination of both with available short residue (SR) in indigenous refineries
6. Development of slurry phase catalyst for residue upgradation
7. Deactivation study of hydro processing catalysts
8. Technology development for making on grade aromatic oil of desired low PCA content from lube distillate
9. Functionalized micro/meso carbon composites and hierarchical materials for hydrocarbon conversion
10. Hydrogenation of CO_2 over nano-catalysts
11. Development of an indigenous process for the synthesis of n-methyl-2-pyrrolidone(NMP)
12. Process for the production of butadiene from n-butane using micro-channel reactor system
13. Development of a process for the synthesis of 3-methylpentane-1,5-diol (MPD)
14. Characterization of bio-oil by NMR and GC-MS
15. Valorization of lignin to value added chemicals
16. Studies on the development of deep eutectic solvents (DESS) as bio-lubes/bioadditives
17. Ionic liquids / immobilized ionic liquids as recyclable catalysts for the alkylation of aromatic compounds
18. Genetic modification of oleaginour microorganisms to enhance biofuel production
19. Isolation, purification and characterization of photosensitive protein from anoxygenic photosynthetic bacteria
20. Bio-degradability test for in-house and outside lubricant samples as per ASTM D5864
21. Study of ethane as fuel for compression ignition engine
22. m-ehl & failure investigation in line contacts
23. Study and development of temperature monitoring unit for in-house R&D works & processes
24. Combustion analysis of SIengine (Euro IV) using alternative fuels like LPG and DME and comparison with gasoline
25. Development of technology for the upgradation of biogas to transportation and cooking fuel
26. Design and development of improved biomass stove (*Chulha*)
27. Maintenance of sophisticated analytical equipments installed at modern analytical instrument wing
28. Graphene polymer composites for high end uses : preparation characterization & evaluation
29. Optimization of analytical methods for chemical characterization of biomass pyrolysis oil
30. Instrumentation division : to give instrumentation support to the Institute
31. Organic and polymers (including proteins) based photovoltaics (OPV) under novel approaches for solar energy conversion under technologies and products for solar energy utilization through networking

4.2.3 XII पंवयो / संजाल परियोजनाएँ/XII FYP / NETWORK PROJECTS

- Organic and Polymers (Including Proteins) Based Photovoltaics (OPV) Under Novel Approaches For Solar Energy Conversion Under Technologies And Products For Solar Energy Utilization Through Networking

1. Energy-efficient Technologies (E2++)

- Development of adsorption-based technology for separation of propane and propylene
- Metal organic framework (MOF)-based materials for practical storage and delivery of natural gas as transportation fuel
- Upgradation of petroleum residues using unconventional energy sources

- Valorization of difficult-to-process low-value feed-stocks from petroleum streams using the non-HDS route
- Process intensification using micro-channel reactors for future transportation fuels : PIFF (Process Intensification for Future Fuels)
- Membrane technology for hydrogen recovery from low hydrogen-bearing refinery off-gases
- Production of high-value alpha-olefins from low-value feed-stocks
- Development of membrane separation technology for gasoline vapour recovery from hydrocarbon air mixtures

2. Bio-mass- to-Energy (Bio-En)

- Advanced bio-fuels / energy products from algae
- Conversion of lingo-cellulosic bio-mass to renewable jet fuel
- Hydrothermal upgradation of lignocellulosic bio-mass to bio-crude/value-added hydrocarbons
- Technology development for fast pyrolysis of bio-mass to liquid hydrocarbons

3. Catalyst for Sustainable Energy (ECat)

- Photo-assisted conversion of carbon-di-oxide to hydrocarbon fuels
- Utilization of iso-butylene obtained from refinery C_4 stream for production of p-xylene
- Hydro-processing route to new-generation, future transportation fuels
- Electro-active nanoporous oxide films with improved ionic and electronic conductivities for development of energy storage devices (EANO)
- Catalyst development for conversion of naphtha to diesel and branched paraffin-rich gasoline
- Synthesis of efficient catalysts from economic and renewable sources useful for fuel production
- Efficient use of hydrocarbons in refinery off-gases through alkylation
- Development of a new-generation solid basic oxide or hydrotalcyte-supported catalyst and its kinetic model for fixed-bed sweetening of heavier petroleum fractions
- Development of nano-catalysts for conversion of methane to lower olefins
- Centre for studies on mechanistic kinetics of conversion of non-refinery/refinery feed-stock to basic petro-chemicals
- Catalyst development for hydroprocessing of residues
- Carbon-Free Hydrogen Production using H_2S in a petroleum refinery

4. New-generation Lubricants & Additives (GenLube) (11)

- Strategic initiative to develop economical, eco-friendly lubricants from low-cost feed- stocks
- Lubrication capabilities of graphene and its inorganic analogues
- Potential metal phosphorus and sulphur-fee additives for lubricating oils as a substitute to ZDDP
- New-generation multi-functional lubricating oil additives
- New-generation multi-functional additives for bio-fuels and blended fuels
- Study on compatibility behaviour of new-generation lubricants with engineering materials
- Development of novel additives to improve pipeline flow of blends of high - and low-pour crude oils
- Study of the molecular level interactions of bio-lubes and bio-additives

5. Research Initiative for Low Emissions (RILE)

- Assessment of real-world and ultra-fine particle emissions from vehicles (WP1)
- Preparation and evaluation of new catalysts for direct decomposition of NO (WP4)
- Development of a nano-structured fuel-born catalyst for PM emissions reduction in engine exhaust and for fuel economy improvement
- Development of bio-lubricants and additives for non-edible vegetable oils for engine applications

6. Waste-to-Wealth : Waste Plastics (W2W)

- Research Initiative for environment-friendly thermo-chemical conversion process for e-waste plastics
- evelopment of an environment-friendly process for

conversion of waste plastics (production, process, and municipal waste) to value-added products

- Bio-diesel and thermoplastics from wastes : Poultry chicken feather (Keratin)

7. Advanced Carbon Materials (AdCarbMate)

- Synthesis of 'Carbon nano-tubes' and 'Carbon fiber snalogue' utilizing asphaltene and resins from heavy ends of crude oil
- Development of a lab process for production, extraction and utilization of 'graphene' from heavy petroleum ends
- Development of petroleum-derived carbon wool and its carbon nano-tube composite

8. Bio-catalysts for Industrial Application & Green Organic Synthesis (BIAGOS)

9. Development of Sustainable Processes for Edible Oils with Health Benefits from Traditional and New Resources (PEOPLE HOPE)

10. Centre for Bio-therapeutic Molecule Discovery (BIODISCOVERY)

11. Catalysts for Speciality Chemicals

12. A Multi-scale Simulation and Modelling Approach to Designing Smart Functional Materials for use in Energy, Electro-chemistry and Bio-mimetics (MSM)

13. Natural Products as Affordable Healthcare Agents (NaPAHA)

14. Speciality Materials Based on Engineered Clays (SPECS)

15. Recovery of Pure Rare Earth Metals Such as La, Ce, Pr, Nd (Mostly Used in FCC Catalysts and Auto Exhaust Catalysts) Through Improved Solvent Extraction Processes From its Ore/Spent Metals/ Spent Catalysts etc. [Under the 'Sustainable Technologies for the Utilization of Rare Earths (SURE)' programme]

16. Thin Film Lubrication For Micro Machine Elements Under Robotics and Micro Machines (rom)

17. Process Development For Post Combustion CO_2 Capture

18. Clean Coal Technology (Tap Coal) - "CO_2 Utilization in the Synthesis of Fuels"

4.3 संपन्न हो चुकीं परियोजनाएँ/Projects Completed

4.3.1 प्रायोजित/Sponsored

1. Development of adsorption technology for recovery of CO_2 from power plant flue gas
2. Carrying out revamp study of sour water stripper unit at refinery-ii in Manali refinery at CPCL, Chennai: (phase-i: carrying out the adequacy study)
3. Studies on value addition of NGL through production of rubber solvent
4. Pinch analysis of SDU (solvent dewaxing unit) of Digboi refinery
5. Study and pinch analysis for enhancement of pre heat recovery in cdu-2 and to process 0.5 MMTPA ARAB mix crude post IREP
6. Detail technical evaluation of RCO for production of paraffin & microcrystalline waxes at Guwahati refinery : phase-I studies
7. Process optimization study for mibk deoiling of MVGO and HVGO distillates for production of paraffin & microcrystalline waxes at Guwahati refinery
8. Application of biofuels for aviation : green jet fuel from *Jetropha* oil (biojet) and bioethanol
9. Nano-structured porous inorganic oxide materials with tailored pore size and their coatings for application to catalysis, environment and for inclusion of bio-molecules
10. Functionalized hierarchical nano-composites materials for synthetic and renewable fuels production
11. Quick explorative study for conversion of naphtha feed on iip' s catalyst for the possible production of diesel range hydrocarbons
12. Mat testing of HPCL (V) catalyst
13. Bio-jet fuel- a key to future green and sustainable aviation
14. Pinch analysis of propane deasphalting (PDA) unit
15. Preparation of white paper on helium gas
16. Development of process for normal dodecane fraction from straight run kerosene obtained from petroleum refinery

17. Utilization of carbon dioxide for the production of fuel and chemicals
18. Valorization of glycerol for biodegradable base fluids and new biofuel formulations
19. Production of biodiesel from low cost feed stocks using heterogeneous catalyst
20. Biodegradability test by ASTM 5864-05
21. Fire resistant property test as per is7897, 1975 and bio-degradability test as per ASTM d5864-05 of fire resistant hydraulic fluid hfdu-68
22. Boundary lubrication capabilities of ionic liquids and its futuristic applications to lubricant development
23. Study on tribo-chemical events of ionic liquids
24. Comparative testing and analysis of Russian and Indian hypoid oils used in mi-8/mi-17/mi-17 1v helicopters
25. Tribo performance investigation of fire resistant hydraulic fluid "lub-hydraul HFD-68
26. performance investigation of scuffing load capacity of lubricating oil using FZG test method
27. An investigation of shock load characteristics of high EP content gear oil
28. Evaluation of engine as per IS-7347-1974
29. Optimization of CNG 3 wheelers for emissions
30. Investigation on the drive train losses and fuel efficiency of passenger cars
31. Power train and fuel efficiency analysis of passenger cars
32. Optimization of CNG 3 wheelers for emissions
33. Greenhouse gas inventory for transports sector for biennial update report
34. Study on fuel additive (Kanti consultancy) for fuel economy and emissions on a diesel SUV
35. Evaluation of synthetic FRHF as per is 7895
36. Evaluation of fire resistant hydraulic fluid samples
37. Evaluation of fire resistant hydraulic fluid samples
38. To study of deposit characteristics on two numbers of Suzuki access scooters engine components
39. to study of deposit characteristics on four numbers of Honda Activa scooters engine components
40. To study the deposit characteristics of six numbers of swift ZDI engine components
41. To study deposit characteristics on four numbers of Tata ace diesel engine components
42. To study the deposit characteristics of two nos. of four-stroke, two wheeler petrol engines components
43. To study the deposit characteristics of two nos. of four-stroke, two wheeler petrol engines components
44. Field trials on four stroke motorcycles for performance evaluation of engine oils
45. Field trials on four stroke motorcycles for performance evaluation of engine oils
46. Investigating the emissions characteristics of portable genset
47. Performance evaluation of new engine lubricant formulation for four-stroke, two-wheeler through field trials
48. Study of running in, performance and endurance of two genset engines (4575TC and 3335TC) as per is 10000
49. Study of running in, performance and endurance of genset engine 3255 as per is 10000
50. Evaluation study of Mangala crude oil from HPCL Mumbai
51. Preparation of narrow fraction from VGO cut of Essar Oil Ltd
52. Feasibility studies on of gas oil sample (HSD) from ONGC, Hazira
53. Study of naphtha sample from GAIL, Vijaipur
54. Studies of impurities inbenzene from Atul Ltd, Atul, Valsad, Gujarat
55. Studies of coker unit samples from HMEL, Bhatinda
56. Study of speciality of oil from Standard Greases & Specialities Pvt Ltd.
57. Evaluation study of crude oil from HMEL, Bhatinda
58. Evaluation studies on nagayalanka crude oil samples
59. Evaluation studies on treated curde oil sample point tank B, SDV U/S from Cairn India Ltd. for bench mark pricing
60. Short evaluation studies on viramgam crude oil from Cairn India Ltd.

61. evaluation of oils for homogeneity miscibility test
62. Short evaluation studies of RJ crude oil from Cairn India Ltd. for bench mark pricing
63. studies on treating oil from Kmml, Kerela
64. Studies on evaluation of the gas condensate of DDW gas field of kg offshore field from GSPC
65. Studies on wash oil from GAIL, Patta
66. Short evaluation studies on Suvali crude oil sample from Cairn India Ltd. for bench mark pricing
67. Short evaluation studies on condensate sample from Vibhuti shipping
68. Study of castrol oil samples from SSP, Chandigarh
69. Studies of speciality oil from CEMILAC, Ministry of Defence, Bangalore
70. Study on gas condensate from central excise Dibrugarh
71. Testing of ISO HV-68 and VG-32 oil samples
72. Sample encapsulation in glass ampoules and subsequent stone cutting

4.3.2 संस्थानगत/In-house

1. Studies on the flow behaviour of diesel matrix at different temperature : wax additive interaction in relation to composition and properties of waxes
2. Feasibility study for recovery of butanol from fermentation broths
3. Feasibility study for upgradation of residual fuel oil (RFO) using non HDS route
4. Degradation / depolymerisation of commingled plastic to produce value added products
5. Feasibility study for the production of pure benzene from light FCC gasoline
6. Selective oxidation of propylene to propylene oxide with molecular oxygen over nano-catalysts
7. Utilization of bio-feed (glycerol) in the FCCU for fuel and chemicals
8. Development of process for detergent grade alpha-olefin sulphonates by using linear alpha olefins (C14-C18 range) from coker distillate of an Indian refinery
9. Process for the production of para-tert-butylphenol
10. Co-processing studies of biomass derived fast pyrolysis bio-oil with vacuum gas oil in fluid catalytic cracking (FCC) unit
11. Steam reforming of pyrolysis oil for hydrogen production
12. Development of new generation lubricants for micro electro mechanical system (MEMS)
13. Production of village level biodiesel from non-edible oils (locally available)
14. Synthesis, characterization and triboevaluation of cellulose fatty esters for bio-lubricant applications
15. Alternative fuels combustion studies under controlled engine operating parameters
16. Study on the effect of fuel sensitivity on performance and emissions of modern spark ignition engines
17. In-use particulate emission comparison of diesel and natural gas vehicles for Indian road conditions
18. Synthesis, development, characterization and evaluation of graphene-TiO_2 hybrid material for enhancement of photovoltic cell efficiency
19. Calibration of master instruments
20. Data entry operator salary

4.3.3 XII पंवयो परियोजनाएँ/XII FYP PROJECTS

Bio-mass-to-Energy (Bio-En)

- Integrated hydro-pyrolysis of lingo-cellulosic bio-mass to value-added hydrocarbons
- Microwave-assisted catalytic pyrolysis of bio-mass and characterization of bio-oil

Bio-mass-to-Energy (Bio-En)

- Development of thin-layer activation (TLA) technique for studying corrosion behavior of high tan crude oils

5

अनुसंधान एवं विकास अवसंरचना में बढ़ोतरी

Enhancing R&D Infrastructure

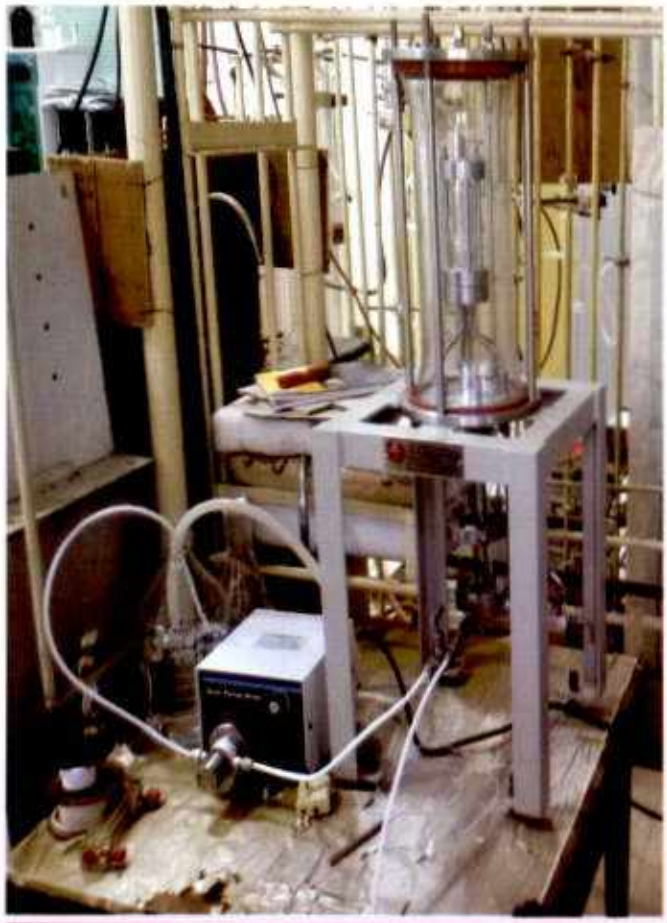
5.1 सृजित की गई नई सुविधाएं / New Facilities Created

Customized Online-Refinery Gas Analyzer *for analysing all permanent gases along with C1-C5 hydrocarbons and oxygenates was installed in the month of June, 2014.*

UV-VIS Spectrophotometer

Customized Online-Refinery Gas Analyzer

In-situ *IR*



Wetted Wall Column

Gas Chromatographs (GC)

Particle Size Analyzer

Cell Coating Equipment

CHNS Analyzer

HPLC Equipment

Solar Cell Equipment

Gas Chromatograph with Mass Spectrometry (GC-MS) and Atomic Emission Detector (AED)

Flat Cuvette Photo-bio-reactor

Vibratory Sieve Shaker

A basic vibratory sieve shaker can be used to carry out both dry FCC catalyst particle size analyses in a particle size from 63 to 2.5 mm.

Vibratory Sieve Shaker

High Pressure Micro-reactor System (Hi-Tech)

A high-pressure micro-reactor facility has been created at the-CSIR-IIP for carrying out reaction studies on the materials synthesized in the laboratory

High-pressure Micro-reactor System (Hi-Tech)

Universal Quadruple Mass Gas Analyzer

QGA compact bench top mass spectrometer is a universal analyzer for continuous real-time multi-species analysis of both gases and vapours upto a maximum pressure of 2 bar absolute and mass range to 200amu (max) and detection levels to 100ppb

Universal Quadruple Mass Gas Analyser

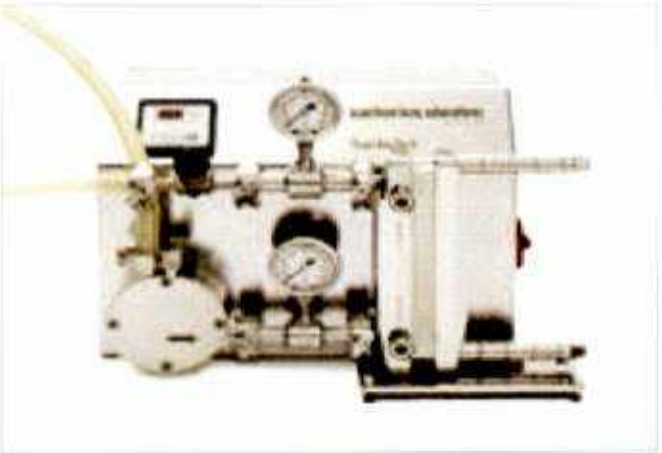
In-situ Fermenter

In-situ *sterilizable bio-reactor system with MFC and controlled through PLC. The system can be used for scale-up study up to 10L level for production of cell bio-mass or bio-products.*

In-situ *Fermenter*

TFF

In chemical engineering, bio-chemical engineering and protein purification, cross-flow filtration (also known as tangential flow filtration) is a type of filtration (a particular unit operation). Cross-flow filtration is different from dead-end filtration in which the feed is passed through a membrane or bed, the solids being trapped in the filter and the filtrate being released at the other end. Cross-flow filtration gets its name because the majority of the feed flow travels tangentially across the surface of the filter, rather than into the filter.



TFF

GCXGC-MS

Thermal Stability Tester

The test equipment is capable of determining the thermal stability of petroleum and synthetic-base hydraulic fluids as per the standard test procedures of ASTM D 2070

6

महत्वपूर्ण घटना-क्रम

Important Events

6.1 स्थापना दिवस /Foundation Days

6.1.1 सीएसआइआर–भापेसं स्थापना दिवस, 14 अप्रैल, 2014/CSIR-IIP Foundation Day, April 14, 2014

The Institute celebrated its 54th Foundation Day on April 14, 2014. A delegation from the Institut Français du Petrole (IFP) and AXENS-IFP Group Technologies, led by Mr Georges Picard, Executive Vice President and CEO, IFP Energies nouvelles (IFPEN), which especially flew from France to our Institute, graced the occasion. He was accompanied by Mr Daniel Champlon, Director, International Relations; Mrs Yolande Rondot, Deputy Director, International Relations Division; Mr Eric Caprani, Technology Development Director and Mr. Jean-Paul Margotin, Managing Director, Axens.

Mr Georges Picard, Executive Vice President & CEO, IFPEN, and the Chief Guest of the function, expressed his keenness in collaborating with the CSIR-IIP to find a market for selling their technologies in India while helping promote the CSIR-IIP's technology abroad.

Mr Daniel Champlon, Director, International Relations, IFPEN, gave a presentation on *'Energy: geopolitical aspects and the impact of technological advances for the future'*. He reminded that most of the oil reserves are located in the Middle East. There is a need to use the oil carefully and to switch over to newer technologies.

In his address, Mr Jean-Paul Margotin informed that IFPEN and AXENS India have worked together to sell the latest technologies in India and have so far marketed ~70 projects in India and are planning to expand further with the help of the CSIR-IIP.

Dr M O Garg, Director, CSIR-IIP, informed the audience that for setting up the CSIR- IIP, the CSIR entered into an agreement with the Institut Français du Petrole (IFP), the premier institute of France, and indeed of Europe, in the petroleum sector. Our Institute started functioning on 14th April, 1960, which is observed as its Foundation Day. He said that the Institute has been contributing to the growth of petroleum refining and petrochemical industry for the last 53 years. During these five decades the CSIR-IIP has developed about 78 technologies/ processes/products. A large number of these have been commercialized against global competition. Realizing the finite availability of fossil fuels, research has been initiated in the areas of alternative fuels including bio-fuels, bio-jet fuel, waste plastics-to-petroleum products, etc.

Visitors from abroad adorn the dais on Foundation Day

Chief Guest Mr Georges Picard speaking on the occassion

6.1.2 वैऔअप स्थापना दिवस समारोह, 20 अक्टूबर, 2014/CSIR Foundation Day Celebrations, October 20, 2014

The 72nd CSIR Foundation Day was celebrated at the Institute on 20th October, 2014. The main function was held at Dr Lovraj Kumar Auditorium. Mr Narendra Taneja, National Convener-Energy Cell (BJP) was the Chief Guest of the function.

Mr Taneja said that in India roughly 70 crore people have no access to cooking gas and more than 40 crore have no access to electricity and even those 70% who

Mr Narendra Taneja initiates proceedings as Dr M O Garg and Mr L S Negi look on

At the dais: Dr D C Chamola, Mr Narendra Taneja, Dr M O Garg & Mr L S Negi

do have access to electricity are below energy poverty line.

Per capita energy consumption in India is the lowest in the world. If India has to provide electricity and gas to all its population, the next 30 years are very crucial. It is very unlikely that we will depend upon some other sources of energy rather than oil and gas. We need more refineries so that more and more crude can be refined and electricity and other forms of energy are available even to the person at the end of the line. In India, we believe in building institutions because we are aware that economy alone is not enough to extend the benefit of research to all its population.

Welcoming the Chief Guest, Dr M O Garg, Director, CSIR-IIP, defined CSIR as an organization which believes in ***C**onceptualization of ideas, **S**cientific **I**nnovation and **R**esearch* to develop technologies, their scale-up, follow-up with the clients and commissioning of the plants. The CSIR has proffered water and waste-water treatment technologies including recycle, reuse and zero discharge. The other important contributions of CSIR have been remediation technologies for hazardous waste-contaminated sites, turning barren lands into productive ones and development of a variety of environmental materials for pollution abatement. CSIR is endeavouring to make available the latest cutting-edge and environmentally sound technologies at a reasonable price. Technology transfer has been the prime focus of CSIR in the social, economic and environmental contexts of the receiving societies.

Mr Taneja addressing the audience

He said that CSIR-IIP, right from its inception, has been working on these lines and has developed a large number of technologies for the refining and related industries. He also highlighted the role of the CSIR-IIP in human resource development of the industry.

Dr D C Chamola, Sr. Hindi Officer, CSIR-IIP compered the function. He said that as a part of the celebrations, the 4th *District-Level Carrom Tournament* was also organized.

The employees who had retired during the year gone by were honoured with a shawl, a *'samman patra'* and a memento while the services of the employees having completed 25 years of service were recognized by way of presenting mementoes to them. The winners of the 4th *District-Level Carrom Tournament* held on this occasion were also given away the prizes by the Chief Guest.

The vote of thanks was presented by Mr L S Negi, Controller of Administration, CSIR-IIP.

6.2 राष्ट्रीय दिवस /National Days

6.2.1 अंबेडकर जयंती, 14 अप्रैल, 2014/ Ambedkar Jayanti, April 14, 2014

On this occasion, the Institute also celebrated Baba Bhim Rao Ambedkar's birthday. Floral tributes were paid by the Dignitaries and the members of the Institute's SC/ST Welfare Association. Dr M O Garg, Director, CSIR-IIP highlighted Baba Sahib's role on building modern India.

Homage to Dr Ambedkar by Dr M O Garg

6.2.2 राष्ट्रीय प्रौद्योगिकी दिवस, 19 मई, 2014/ National Technology Day, May 19, 2014

Dr D N Rihani, Ex. Executive Director, TECHNIP India Ltd., NOIDA delivered a lecture at the Institute as a part of the National Technology Day celebrations.

National Technology Day, Dr D N Rihani said, is celebrated as a symbol of scientific inquiry, technological creativity and the translation of that quest in the integration of science, society and industry. This day is also celebrated to honour technological innovation and its successful commercialization which makes the fruits of research reach the people at large.

He said that the use of technology is not restricted to one section of the society. Advances in atomic research are used by the doctors in the treatment of cancer. Nuclear submarines are also used for the study of aquatic life. Technology development means planning, resource and execution. All have equal importance.

Dr M O Garg, Director, CSIR-IIP, in his welcome address, described the technological capabilities of India. He emphasized on the need for the development of cutting-edge technologies which have low cost of operation and are environment-friendly. He showed concern over the rising prices of crude oil and its availability.

Dr S K Sharma, Chairman, Celebration Committee, said that initially in 1999 the day was celebrated to recognize excellence in Science & Technology of the defence sector only. But now, it is celebrated to recognize achievements in all fields of Science and Technology. He said that the day not only gives an opportunity to derive inspiration and strength from our past achievements but also to critically review our present position and to plan for the future for developing cutting-edge technologies.

Dr D N Rihani inaugurates the National Technology Day function

Dr D N Rihani delivering the Technology Day lecture

It may be recalled that, on 11 May in 1998, India had conducted the second successful nuclear test at Pokharan in Rajasthan and thus, secured a position among the nuclear powers of the world. To commemorate India's enhanced status as a technologically developed nation and to remember the contribution of the engineers, scientists, policy makers and economists in the pursuit of technological excellence, the day is celebrated as the National Technology Day all over India. For CSIR-IIP, which has core activities of scientific research and technology excellence, the day is much more significant.

Mr L S Negi, Controller of Administration, CSIR-IIP, proposed the vote of thanks. The lecture was attended by the scientific, technical & administrative staff of the Institute, invited guests from local organizations and the general public.

6.2.3 स्वतंत्रता दिवस, 15 अगस्त, 2014/ Independence Day, August 15, 2014

The 68th Independence Day of the country was celebrated with great élan on August 15, 2014. Dr M O Garg, Director, hoisted the Tricolour on this occasion. A

Cultural show by the KV-IIP school-children

Drawing Competition was organized for the children of the staff members on this occasion.

The Kendriya Vidyalaya, CSIR-IIP children staged captivating cultural performances on this occasion.

6.2.4 गणतंत्र दिवस समारोह, 26 जनवरी, 2015 / Republic Day Celebrations, January 26, 2015

केंद्रीय विद्यालय की छात्राओं द्वारा दी गई सांस्कृतिक प्रस्तुति का एक दृश्य

निदेशक, भापेसं द्वारा ध्वजारोहण

सदा की भाँति संस्थान में देश का 66वाँ गणतंत्र दिवस सोत्साह मनाया गया, जिसमें डॉ0 एम ओ गर्ग, निदेशक, सीएसआइआर–भापेसं द्वारा ध्वजारोहण, सुरक्षा गारद की परेड तथा केंद्रीय विद्यालय, आइ आइ पी द्वारा सांस्कृतिक प्रस्तुतियाँ दी गई।

6.3 राज्य–व्यापी मिशन /State-wide Missions

6.3.1 तेल एवं गैस संरक्षण पखवाड़ा, 16–31 जनवरी, 2015/Oil & Gas Conservation Fortnight, January 16-31, 2015

"We will have to make energy conservation a part of our lifestyle. This requires government, institutional and personal involvement. We will have to make special efforts to conserve petrol and power in the transport sector". This was stated by the Hon'ble Chief Minister of Uttarakhand, Mr Harish Rawat, while inaugurating the Oil and Gas Conservation Fortnight at the Institute. He

Mr Harish Rawat, CM, Uttarakhand lights the lamp. Mr Agrawal (far left), Dr M O Garg (second from left) and Mr Mayank Bhatnagar (far right)

said that Uttarakhand is proud to have CSIR-IIP which has contributed immensely not only to country but is also providing scientific inputs to other countries.

The CM said that development was synonymous with environmental conservation and urged CSIR-IIP, HPCL, BPCL, ONGC and other oil companies to design a comprehensive plan to convert traffic lights at the road intersections into automotive mode. This will save both, energy as well as environment. He assured that he will help to launch it at Dehradun and Haldwani in the first phase where congestion is more.

Vehicle drivers would also have to learn about fuel efficiency. He asserted that people could also be encouraged to conserve energy at home. The CM lamented that even through we praised efforts made by other countries towards power conservation, we personally are reluctant to work for it.

The Hon'ble Minister of Sports, Forests and Wildlife, Law & Justice, Govt. of Uttarakhand, Mr Dinesh Agarwal, who was also present on the occassion emphasised that public awareness be created to achieve energy

Dignitaries on the dais

The CM addresses

Mr Agrawal speaks

conservation. He informed the gathering that the Uttarakhand Goverment had introduced several flagship programmes for the first time to ensure maximum participation in energy and environment conservation. With these efforts, we have connected conservation with the people's livelihood.

Dr M O Garg, Director, CSIR-IIP, appealed to the Chief Minister to encourage the use of solar power in Uttarakhand, considering the abundance of this source of renewable energy in the State. Stating that though the international prices of crude oil had dropped by about 50 per cent in a period of three months, the prices might not remain stable for long and could rise again as seen in the past. "We should be prepared for any eventuality. The State needs to promote the use of solar power for which it is requested to resume the subsidy provided earlier," he said. The State-level Co-ordinator of Oil Companies, Mr S K Sinha and Senior Regional Manager, HPCL, Mr Mayank Bhatnagar, also spoke on the occasion.

Mr Bhatnagar informed that 40,000 to 45,000 vehicle drivers were being trained in oil conservation fortnight. Students from the Kendriya Vidyalaya, CSIR-IIP and other schools of the town were also present on the occasion. Later, a human chain with the message 'Save Oil' was formed by the students & the people present.

The 'SAVE OIL' chain

6.4 अभिज्ञतावर्द्धक गतिविधियाँ/Exposure Events

6.4.1 विद्यार्थियों के दौरे /Students' Visits

Students, etc. from the following institutions:

- A team of B.Tech. (Chemical Engineering) and M.Sc. (Chemistry) students of the Teerthanker Mahaveer University, Moradabad, April 3-4, 2014
- St. Kabeer Academy, Dehradun, July 16-17, 2014
- Rashtriya Indian Military College (RIMC), Dehradun, July 30, 2014
- Graphic Era University, Dehradun, August 20, 2014
- The State of Jammu & Kashmir, September 12, 2014
- A N Patel Post Graduate Institute, Anand, Gujarat, September 18, 2014.
- M.Tech. students (Nano-science & Nano-technology) from the University of Delhi along with their faculty members, November 19, 2014.
- 100 students of the Jawahar Navodaya Vidyalaya (participating in the Regional Science Congress at the Jawahar Navodaya Vidyalaya, Shankarpur, Dehradun) along with their faculty members, November 14, 2014.
- 10 students (M.Sc.-Chemistry) from the Uttaranchal (PG) College of Technology & Bio-Medical Sciences, November 10, 2014.
- Uttaranchal University, Dehradun, January 20, 2015
- Rashtriya Indian Military College (RIMC), January 30, 2015
- Unison World School, Dehradun, February 13, 2015

6.4.2 अपनी क्षमताओं का प्रकटन /Showcasing Our Capabilities

National Vendor Development Programme-Cum-National Exhibition, 'Industry & Technology Expo 2015'

The Institute participated in the National Vendor Development Programme-cum-National Exhibition *'Industry & Technology Expo 2015'*, organized jointly by the Industries Association of Uttarakhand (IAU); the Micro, the Small & Medium Enterprises Development Institute, Haldwani and the Government of Uttarakhand at the Parade Ground, Dehradun during February 12-15, 2015. The Institute was represented by Dr Atul Ranjan, Mr Pankaj Arya and Mr G B Khatri.

6.5 अनुसंधान–प्रबंधन गतिविधियाँ/ Research Management Events

6.5.1 सीएसआइआर–भापेसं अनुसंधान परिषद् की 41वीं बैठक, 4 फरवरी, 2015/The 41st CSIR-IIP Research Council (RC) Meeting, February 4, 2015

The 41st Meeting of the Research Council of the Institute was held on February 4, 2015 at the CSIR-Science Centre, New Delhi. Professor D V Khakhar, Chairman, Director, IIT-Mumbai; Professor I M Mishra, IIT-Roorkee; Dr A V Sapre, Group President, RIL-Mumbai; Mr D M Katre, Site President, RIL, Rasayani; Mr Abhay Bakre, ED, PCRA-New Delhi; Dr B D Kulkarni, Distinguished Scientist, NCL, Pune; Dr (Ms.) M Lakshmi Kantam, Director, CSIR-IICT, Hyderabad; Mr Indu Bhaskar, Department of Scientific & Industrial Research, New Delhi; Mr Anoj Chadar, CSIR HQ, New Delhi and Dr M O Garg, Director, CSIR-IIP (and DG-CSIR) were present. Divisional Heads of the CSIR-IIP and several other scientists of the Institute presented papers on the occasion.

6.6 हमारा कीड़ा–पक्ष/Our Sporting Side

6.6.1 जिला–स्तर की दो–दिवसीय कैरम प्रतियोगिता का आयोजन/ Organization of a Two-day District-Level Carrom Competition

72वें सी एस आइ आर स्थापना–दिवस के उपलक्ष्य में संस्थान के स्टाफ क्लब द्वारा आयोजित दो–दिवसीय **'चतुर्थ जिला–स्तरीय कैरम प्रतियोगिता'** का आयोजन 20 व 21 सितंबर, 2014 को आइ आइ पी समुदाय केंद्र में किया गया।

परिणाम इस प्रकार रहे :

'एकल' वर्ग

विजेता: श्री रवीन्द्र,
रक्षा इलेक्ट्रॉनिकी अनुप्रयोज्यता प्रयोगशाला, देहरादून

उप–विजेता: श्री जवाहर, सी क्यू ए आइ, देहरादून

'युगल' वर्ग

विजेता: श्री हसन मंसूर तथा श्री राकेश रावत,
बार ऐसोसिएशन, देहरादून

उप–विजेता: श्री शम्भु प्रसाद ममगाईं तथा श्री सुरेन्द्र राणा,
बार ऐसोसिएशन, देहरादून

6.6.2 46वें शांति स्वरूप भटनागर स्मृति टूर्नामेंट (इनडोअर्स)– जोनल में प्रतिभागिता, 19–21 सितंबर, 2014/ Participation in the 46th SSBMT (Indoors)-Zonal, September 19-21, 2014

सीएस्आइआर–भापेसं स्टाफ क्लब के तत्वावधान में सीएस्आइआर–राष्ट्रीय अंतर्विषयी विज्ञान तथा प्रौद्योगिकी संस्थान, तिरुवनंतपुरम में आयोजित '46वें शांति स्वरूप भटनागर स्मृति टूर्नामेंट–इनडोअर्स *(SSBMT-Indoors)*' (अक्टूबर 19–21, 2014) में सीएसआइआर–आइआइपी से कुल 9 खिलाड़ियों ने विभिन्न प्रतियोगिताओं यथा – बैडमिंटन, टेबल टेनिस, शतरंज एवं कैरम बोर्ड – में भाग लिया। इनमें से 4 खिलाड़ियों ने टेबल टेनिस एवं बैडमिंटन में फाइनल में जगह बनाई। फाइनल के लिए स्थान बनाने वाले खिलाड़ियों के नाम इस प्रकार हैं :–

बैडमिंटन (व्यक्तिगत) : श्री देवेन्द्र राय

टेबल टेनिस (व्यक्तिगत) : श्री एन के रावत।

टेबल टेनिस (युगल) : डॉ सोमेनदास गुप्ता एवं श्री एन के रावत।

टेबल टेनिस (टीम) : श्री एस सी भट्ट,
डॉ सोमेनदास गुप्ता
एवं श्री एन के रावत।

6.6.3 राज्य–स्तरीय अंतर्विभागीय बैडमिंटन टूर्नामेंट

संस्थान के बैडमिंटन दल ने परेड ग्राउंड, देहरादून में 13 सितंबर, 2014 को आयोजित राज्य–स्तरीय अंतर्विभागीय बैडमिंटन टूर्नामेंट में अपने सभी लीग मैच जीतते हुए क्वार्टर–फाइनल तक विजय–यात्रा बनाए रखी। इस टूर्नामेंट में 120 दल सम्मिलित थे।

6.6.4 46वां शांति स्वरूप भटनागर स्मृति टूर्नामेंट (इनडोअर्स)– ज़ोनल अंतिम स्पर्द्धा, 26–28 फरवरी, 2015/Participation in the 46th SSBMT (Indoors)-Zonal Final, February 26-28, 2015

46वें शांति स्वरूप भटनागर स्मृति टूर्नामेंट (इनडोअर्स)–ज़ोनल अंतिम स्पर्द्धा (26–28 फरवरी, 2015) में प्रतिभागिता :

सीएस्आइआर–भापेसं स्टाफ क्लब के तत्वावधान में सीएसआइआर–राष्ट्रीय रासायनिक प्रयोगशाला, पुणे में आयोजित '46वें शांति स्वरूप भटनागर स्मृति टूर्नामेंट–इनडोअर्स *(SSBMT-Indoors)*' (फरवरी 26–28, 2015), में सीएसआइआर–आइआइपी से इन खिलाड़ियों ने बैडमिंटन एवं टेबल टेनिस प्रतियोगिताओं में भाग लिया: श्री देवेन्द्र राय, श्री एस सी भट्ट, श्री एन के रावत एवं श्री मुनिंदरपाल सिंह अरोड़ा।

6.7 कर्मचारी जागरूकता अभियान / Employee Awareness Drives

6.7.1 सतर्कता जागरूकता सप्ताह, 27 अक्टूबर – 1 नवंबर, 2014/Vigilance Awareness Week, October 27 - November 1, 2014

The Vigilance Awareness Week started with a pledge on October 27, administered by the Director, CSIR-IIP. A lecture competition was also organized on the occasion. The topic of the competition was, *'Combating corruption – technology as an enabler'*.

6.8 सामाजिक एवं सांस्कृतिक गतिविधियाँ / Social & Cultural Events

6.8.1 लोहड़ी व मकर संक्रांति/ Lohri & Makar Sankranti

मकर संक्रांति तथा लोहड़ी पर्वों के शुभावसर पर भापेसं स्टाफ क्लब द्वारा 13 जनवरी, 2014 को 'लोहड़ी उत्सव' का आयोजन किया गया।

6.9 समुदाय-स्वास्थ्य अभियान / Community Health Drives

6.9.1 निःशुल्क हृदय-परीक्षण शिविर /Free Heart Check-up Camp

Dr M O Garg, Director, Dr (Mrs) Lalita Bakaya, Dr Ghanshyam Thakkar & others from the CSIR-IIP along with Dr Chetan Sharma & his team from the Bharat Heart Institute at the initiation of the Health Camp

A free Heart Check-up and Bone Densitometry Camp was organized in the Medical & Health Centre, CSIR-IIP, in collaboration with the Bharat Heart Institute, Dehradun, September 6, 2014.

6.9.2 योग शिविर /Yoga Camp

As a part of our drive for life-style modification of patients of diabetes & hypertension and for the well-being of all, a *'Yoga Camp'* was organized in the IIP Medical & Family Welfare Centre, November 28, 2014.

6.10 सम्मेलन / संगोष्ठियाँ / परिसंवाद/ Conferences / Seminars/ Symposia

6.10.1 "उत्सर्जन विनियमों की प्रवृत्तियाँ" विषय पर सीएसआईआर-भापेसं-एवीएल संगोष्ठी, 10 अक्टूबर, 2014 / CSIR-IIP-AVL SEMINAR ON *"TRENDS IN EMISSION REGULATIONS"*, OCTOBER 10, 2014

CSIR-IIP, being a certified testing agency as per the Central Motor Vehicle Rules (CMVR) 126, is associated with the Conformity of Production (COP) & Homologation activity. It also plays a vital role in formulation of policies related to the automotive industry at the national level by providing technical support to the Ministry of Road Transport & Highways (MRTH). In line with our philosophy of sharing experiences with customers, CSIR-IIP and M/s AVL India organized a joint seminar on *'Trends in Emission Regulations'* on 10th October, 2014.

AVL (Anstalt für Verbrennungskraftmaschinen List) is an Austria-based automotive consulting firm as well as an independent research institute. It is the world's largest independent company for development, simulation and testing technology of powertrains and provides first-hand information on the latest trends and innovations in the field of automotive emissions. Indian automotive industry is also gearing up to meet Euro V and VI emission norms in the near future.

Inaugurating the Seminar, Dr. M O Garg, Director, CSIR-IIP said that meeting the fuel quality of Euro IV/V, which the world is heading for, is a big challenge. Emissions from the exhaust of a vehicle depend upon four major factors,

Dr M O Garg lights the lamp to initiate the programme. Mr Nilesh Auchare (M) and Mr Ajay Gogia (R) are also seen

Dr M O Garg flanked by Mr Ajay Gogia (L) and Mr Nilesh Auchare (R) at the seminar

namely, fuel quality, engine compatibility, road and traffic conditions. In India, the first two factors are world-class, but the other two factors are of major concern.

The Chief Guest of the function, Mr Ajay Gogia, Director, Sales, AVL, said that the automobile industry is well set to develop/design the engines for Euro V norms. Mr Gogia has been working with the AVL for 30 years, with deep knowledge and expertise in Engine Test Instruments, Test Beds, Chassis Dynamometer and Transient Testing.

The panel of speakers included experts in the field of emissions from Europe and India. Some key topics covered in the Seminar were :

- HD Engine Testing (Off & On-Road) - Euro VI & EPA 1065
- Light Duty Vehicle Testing
- WLTP, Real Driving Emissions
- Ultra-fine particle emissions
- New-generation transport fuel for emission reduction
- Dimethyl ether- A promising fuel for the 21st century
- Hybrid Testing

The presentations, focussed on emissions, were in the form of invited lectures by reputed international and national experts and provided ample opportunities for an exchange of ideas and forge business relationships.

Delegates from various organizations like M/s Daimler India Commercial Vehicles Pvt. Ltd; M/s Indo Farm; M/s SUD-CHEMIE; M/s Escorts; the IOCL; the Millennium Institute of Technology; M/s Ashok Leyland; M/s Tata Motors; the ICAT, Manesar; M/s Mahindra & Mahindra; M/s Maruti Suzuki besides those from M/s AVL participated in the seminar.

6.10.2 "उद्योगों हेतु ऊर्जा–दक्षता प्रोत्साहन विधियाँ: प्रवृत्तियाँ एवं नवाचार" विषय पर भारतीय–रूसी संयुक्त कार्यशाला 28–29 नवंबर, 2014 /Indo-Russian Joint Workshop On *"Energy Efficiency Advancement Methods For Industries: Trends And Innovations"*, November 28-29, 2014

CSIR-IIP, Dehradun & the GCE Group, St. Petersburg, Russia, organized a joint workshop on *"Energy efficiency advancement methods for industries : trends and innovations"* during November 28-29, 2014.

The workshop was an outcome of the 19th meeting of the Indo-Russian Working Group on Energy and Energy Efficiencey, held at New Delhi. The Group highlighted the importance of co-operation between the two countries for increasing the competence of the Indian industry in terms of improving their energy efficiency. CSIR-Indian Institute of Petroleum, Dehardun, has, over the last several years, led India's efforts to improve energy efficiency of the refining sector by applying advanced techniques of process integration (Pinch Analysis). The GCE Group is a global leader in carrying out energy audits, furnace improvement studies, low-level heat recovery and providing a consolidated road map for energy efficiency projects for a variety of industries. The workshop focussed on the understanding of advanced methods and their applications in energy savings and efficiency improvement of the process as well as the complete process plant. These methods include energy-efficiency bench-marking, energy management system,

Mr Alexey Shorokov from the GCE Group, Russia, lights the inaugural lamp. Also seen are Dr M O Garg, Director, CSIR-IIP, Ms Anastasia Savelena (far left) and Mrs Pooja stand (far right)

(L-R) Dr S M Nanoti, Chief Scientist, CSIR-IIP, Dr M O Garg, Director, CSIR-IIP, Ms Anastasia Savelena, GCE Group, Russia & Mr Alexey Shorokov, GCE Group, Russia share the dais at the workshop

Participants of the Indo-Russian workshop pose for a group photograph

pinch analysis, column targeting, auditing strategy and guidelines for energy managers. The speakers having several years of experience of working in the area of energy efficieny enhancement and energy conservation from Russia and India, delivered the lectures on the above-mentioned topics. The workshop was attended by more than 100 engineers/officers working in this area from various organizations: ONGC, PCRA, Reliance, HPCL, IOCL, BPCL, NRl, EIL, Essar Oil, Petronet LNG, HMEL, Oil India Ltd, GAIL, MECON, Technip, KBR, CII, Kuwait National Petroleum, CPCL, Haryana Power Corporation etc. CSIR-IIP was represented by Dr M O Garg Director, Dr S M Nanoti, and Mr Sunil Kumar, Scientist, while GCE/RUSSIA was represented by Ms Anastasia Savelena, Director, International Dept. of GCE Group, Mr Alexey Shorokov, Technical Director, International Dept. of GCE Group, Mr Johannes Penzkofer, Vice President, GCE Group and Mr Piyush Kant, Sr. Manager, GCE Group.

6.11 विशिष्ट घटनाएं/Special Events

6.11.1 'स्वच्छ भारत' मिशन /'Swachchh Bharat' Mission

As a part of the 'Swachchh Bharat' Mission adopted by the Govt. of India on the intiative of the Hon'ble Prime Minister Mr Narendra Modi, a cleanliness drive was

Dr S M Nanoti, Chief Scientist & Acting Director, leads the Swachchh Bharat activities in the Institute

organized in the Institute on October 2, 2014, in the memory of Mahatma Gandhi, in which all the staff took part.

6.11.2 विश्वकर्मा पूजा /Vishwakarma Pooja

Community lunch being served after the Vishwakarma Pooja

The Vishwakarma Pooja was organized on September 17, 2014, followed by a community lunch.

7

सम्मानदायक विशिष्ट घटनाएँ

DIGNIFYING SPECIAL EVENTS

7.1 सीएसआइआर–भापेसं का गौरव : 'भारत रत्न' प्रो० सी एन आर राव की हमारे मध्य उपस्थिति /CSIR-IIP'S Honour: Bharat Ratna Prof. C N R Rao in our Midst, April 24, 2014

"Real science is done in small laboratories by the people who are mad about it."

–Prof. CNR Rao

The day of 24th April, 2014 would go down as a day of the utmost significance in the history of CSIR-IIP; as on this day Bharat Ratna Prof Chintamani Nagesa Ramachandra Rao, FRS, visited the Institute. CSIR-IIP has, thus, been lucky to have had two Bharat Ratna Awardees in science on its campus: firstly, the former President Dr A P J Abdul Kalam in 2005 and, secondly, Prof CNR Rao on the date. This internationally renowned scientist addressed the scientific community & others of the Institute, and gave a definite direction for future research. In-spite of his hectic schedule, he did not hesitate in inviting questions from the audience after his address and answering them at length. A highly-regarded scientist of the country, Professor CNR Rao was recently honoured with the Bharat Ratna on February 4, 2014. Prof Rao does not hesitate in criticizing the system as he is worried about the future of the higher education and science in India. He was Director of the Indian Institute of Science, Bangalore, and currently works at the Jawaharlal Nehru Centre for Advanced Scientific Research in Bangalore.

Prof Rao is a well-recognized international authority on solid state and materials chemistry, having published over 1,400 research papers and 45 books. He is the third scientist after Sir C V Raman and the former President Dr A P J Abdul Kalam to have been conferred with the Bharat Ratna, the highest civilian award in India. His optimism and passion towards science are rather infectious. He is an institution in himself.

Bharat Ratna Prof Rao lights the inaugural lamp

Prof Rao interacted with the students of various institutions including those of Academy of Scientific and Innovative Research (AcSIR), and spoke on ***'Doing Science in India'***. Prof Rao said, *"People think that launching rockets and making bombs is science, but there is no real science in that and it is only an asymmetric technology. Real science is done in small laboratories by individuals from universities and educational institutions. If India has to produce good scientists, the quality of science has to be promoted. The money invested from the GDP needs to be increased as is done in South Korea and China. To persist with science, a scientist has to face critics with a sense of humour. He has to be mad about his work and deal with a judgemental society. Personal satisfaction and enjoyment help achieve the goal."*

Prof Rao also talked about the pain and pleasure of being a successful scientist. *"We have a large number of bright*

Prof Rao plants a tree in the CSIR-IIP premises

Prof Rao & Dr M O Garg on the dais

Dr Rajendra Dobhal, NRDC, felicitates Dr Rao

students, but they need to work for science in India selflessly. Withonly 15 % sharp IIT-ians working for national projects, the condition will begin to change," he said in a prophetic manner.

He elaborated it further, giving a hopeful note, *"You can't say that Indian science in general is doing badly. We have facilities as good as any university in the world but it has taken us a long time to get here. In India, wherever we have had targeted funding, we have done well. For instance, in the last 10 years, every institution has worked in nano-science and now India is No. 3 in the world in this area of research. This gives us an important lesson. We should do the same in the key areas like energy and disease biology. He further said, "Age is not a constraint for creativity. There are lots of scientific issues for which India has a cause for concern. We need about 400,000 MW of electricity in the next 20 years. We have to think from where we are to get it. So, we have to start finding alternative sources of energy. The overall quality of science here is still not up to the mark. Firstly, this is because universities aren't funded well and are in a very poor state. Everybody wants to become an IIT-ian, but that's not possible. However, if we had 50 other such institutions, we could have bright Indians working there and the quality of research would go up immediately. Secondly, we have to be able to pick the right area of research and invest in it. Young students often lack good institutions where they can further their research. I strongly believe that teachers are responsible for the future of India."*

He also pointed out that there was need to do more in the field of research and development in India and the youth must think of the country first **before taking up jobs abroad**. He said that India could become a super power as it has the distinct advantage of having a large number of young people. Prof. Rao opined, *"Encouraging scientific research, getting such work published, and determination are vital for facilitating progress in science in India. Science will survive even without governments or grants. He lamented that we forget to celebrate science in our lives. The year 2008 marked the 150th anniversary year of our great scientist Sir Jagadish Chandra Bose but no one remembered his contribution as his contribution is not even understood here. Now, the international scientific community acknowledges that without Bose's research, Marconi couldn't have developed the telegraph system. We teach children stupid facts instead of telling them the story of science."*

He advised the Indian scientists, *"Take risks in encountering failure; otherwise no science can be done, as it cannot progress without failure. Indians are used to doing safe science, and hence are not able to do any good piece of work. Therefore, take the lonely route of science, rather than the most followed path. Selfishness is the worst thing in science."*

Giving a glimpse into the history of science, Prof. Rao reminded all that 2011 was the centenary year of the discovery of the atomic structure by Rutherford. Similarly, 2011 was the centenary year of the discovery of superconductivity by Kamerlingh Onnes. *"We must learn from the examples of the past scientists who have invented and evolved technologies that have changed the world forever,"* asserted Rao. Giving examples of how talent can bloom despite constraints, he said that Werner Heisenberg, who gave the uncertainty principle, was a Project Assistant with Niels Bohr. He conducted experiments while Bohr was away on vacation and sent them to a science journal. He was later conferred the Nobel Prize for his work. Michael Faraday was from a

CSIR-IIP honours Prof Rao

Full house : Prof Rao gets all attention from the audience

Dr Rao flanked by students from the KV-CSIR-IIP

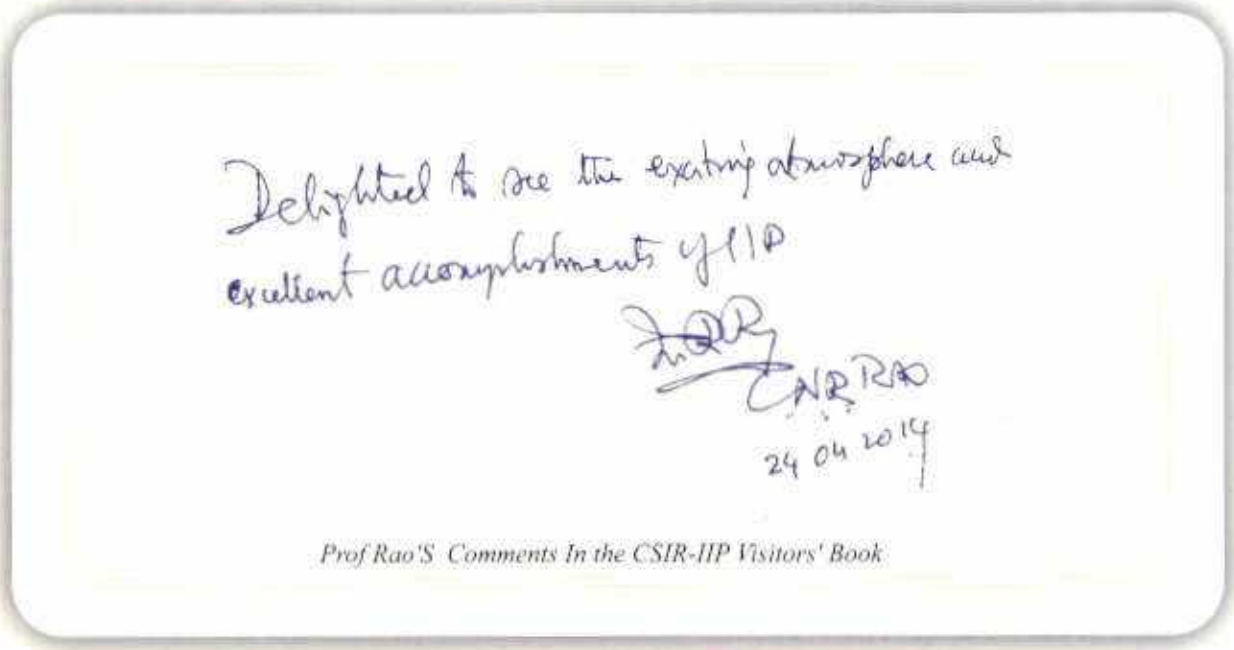
family of limited means and discovered electricit y, magnetism, electrolysis and catalysis.

Dr Rao was humble in concluding that while science had given him a lot, he could give only a little to science. The invitees and the staff of the Institute were mesmerized by his majestic presence and his thought-provoking comments.

Prior to this, Dr M O Garg, Director, CSIR-IIP said, in his welcome address, *"Professor Rao has been influential in formulating the country's science policies over the years. He has been the Chairman of the Scientific Advisory Council to five former Prime Ministers. He is the third scientist after CV Raman and Dr A P J Abdul Kalam to have received the Bharat Ratna."*

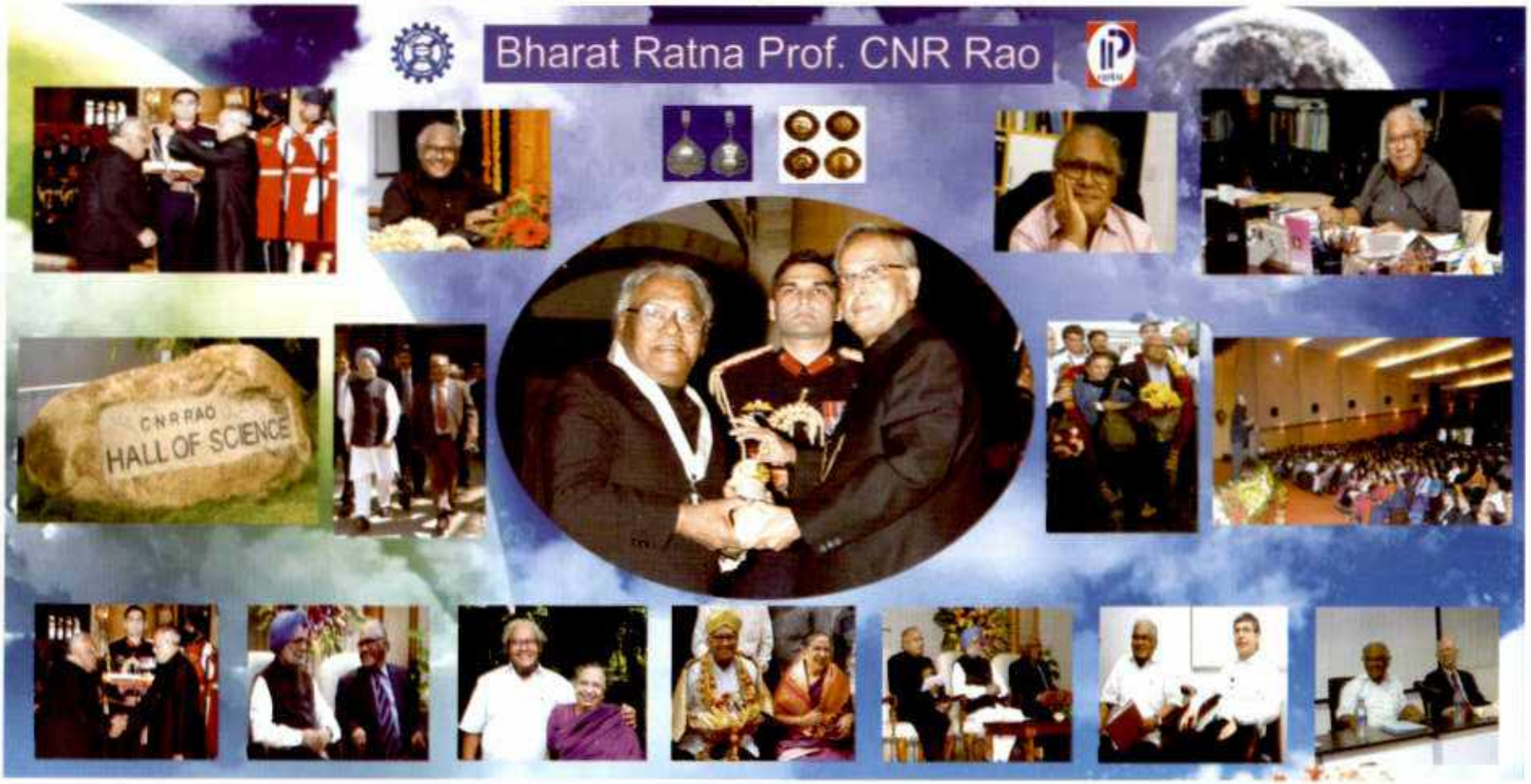
Students from various Universities and Colleges in and around Dehradun including UPES, GEU, Uttarakhand University, Shivalik Engi neering College, JBIT, IIT-R o o r k e e a n dschools like Welham Girls' School, Welham Boys' School, Brightlands School, RIMC, and KV-IIP, came in large numbers to listen to Prof Rao.

After the lecture, Dr Rao and his wife, Mrs. Indumathi Rao were felicitated by Dr M O Garg. Representing the scientific community Dr Rajendra Dobhal, Managing Director, NRDC, Delhi; Mr V K Dhaundhiyal, IAS, D-G, UCOST, Dehradun; Prof V K Jain, Doon University, Dehradun; Prof S P Gupta, Deputy Director, IIT-Roorkee; Dr P K Bhojvaid, Director, FRI, Dehradun; Dr G S Goraya, DDG, ICFRE, Dehradun; Dr S K Saha, Dean, Academics, IIRS, Dehradun; Dr A K Gupta, Director, IRDE, Dehradun and Dr Anil Sood, ONGC, Dehradun, also spoke on the occasion and/or felicitated Dr Rao.



Prof Rao'S Comments In the CSIR-IIP Visitors' Book

भारत-रत्न प्रो॰ सी॰एन॰आर॰राव के यशस्वी जीवन के चित्र-संग्रह से कुछ चयनित पृष्ठ /
Choicest leaves from the album of the illustrious life of the Bharat Ratna Prof C N R Rao



8

अनुसंधान एवं प्रबंधन निकाय

Research & Management Bodies

8.1 सीएसआइआर–भापेसं अनुसंधान परिषद् / The CSIR-IIP Research Council

(1 अगस्त, 2013 – 31 जुलाई, 2016/ August 1, 2013 – July 31, 2016)

अध्यक्ष /Chairman

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Director
Indian Institute of Technology, Bombay
P.O.-IIT, Powai,
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बाहरी सदस्यगण /External Members

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Head, Reliance Technology Group
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Dist. Vadodara (Gujarat)

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Managing Director & Chief Executive Officer
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अभिकरण प्रतिनिधि/Agency Representative

Mr Abhay Bakre
Executive Director
Petroleum Conservation Research Association
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महानिदेशक के नामिती /D-G's Nominee

Dr B D Kulkarni
Distinguished Scientist (Engg. Sciences)
CSIR-Distinguished Professor & Dean, AcSIR
CSIR-National Chemical Laboratory,
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सहोदरी प्रयोगशाला के सदस्य /Sister Laboratory Members

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निदेशक /Director

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स्थाई आमंत्रिती/Permanent Invitee

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सचिव/Secretary

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8.2 सीएसआइआर–भापेसं प्रबंधन परिषद / The CSIR-IIP Management Council

(1 जनवरी, 2014 – 31 दिसंबर, 2015/ January 1, 2014 – December 31, 2015)

अध्यक्ष /Chairman

Dr M O Garg
Director

आंतरिक सदस्यगण /Internal Members

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Chief Scientist

Dr A K Sinha
Principal Scientist

Dr Sanat Kumar
Senior Scientist

Dr Deepti Agarwal
Scientist

Mr D P Bangwal
Sr. Technical Officer (3)

Mr B M Shukla
Chief Scientist
Head, RPBD

CoFA/F&AO
CSIR-IIP

Mr L S Negi
CoA (Secretary)

बाहरी सदस्य /External Member

Prof S K Bhattacharya
Director
CSIR-CBRI, Roorkee

9

राजभाषा

Official Language

9.1 'राजभाषा हिंदी विशिष्ट व्याख्यानमाला' / 'Official Language Special Lecture Series'

9.1.1 '19वाँ पुष्प', 27 जून 2014

भारतीय पेट्रोलियम संस्थान के राजभाषा अनुभाग द्वारा आयोजित 18वें राजभाषा हिंदी विशिष्ट व्याख्यान में मुख्य अतिथि प्रो. आरिफ नज़ीर, अध्यक्ष, हिंदी विभाग, अलीगढ़ मुस्लिम विश्वविद्यालय, अलीगढ़ थे ।

'राजभाषा हिंदी और उसका कार्यान्वयन' विषय पर बोलते हुए प्रो. नज़ीर ने बताया कि राज्य सरकार के कार्यों में प्रयोग होने वाली भाषा ही राजभाषा है। हमारा देश बहुभाषी है और हिंदी बहुत पहले से प्रचलित है। प्रो. नज़ीर ने 'हिंदी' शब्द की उत्पत्ति और हिंदी के लिए अमीर खुसरो के योगदान को स्मरण करते हुए कहा कि हिंदी में चूंकि ज्ञान का प्रचुर भंडार है, इसलिए हमें ज्ञान प्राप्ति के लिए हिंदी पढ़नी चाहिए। प्रो. नज़ीर ने हिंदी के विस्तृत फलक में रामचरित मानस और तुलसी, कबीर, सूरदास, बिहारी, भारतेन्दु हरिश्चंद्र, प्रतापनारायण मिश्र, मैथिलीशरण गुप्त आदि–आदि की चर्चा करते हुए कहा कि आज ऐसे ज्ञानियों द्वारा प्रयुक्त हिंदी भाषा की सेवा की आश्यकता है जिसे संस्थान के वैज्ञानिक, विज्ञान विषयों की पुस्तकें आदि लिख कर आगे बढ़ा सकते हैं। **बल्कि अब हिंदी में वैज्ञानिक साहित्य की अधिक आवश्यकता है।** हिंदी में कार्य आसान है, जो बोलते हैं, वही लिख सकते हैं। प्रो. नज़ीर ने कहा कि हिंदी में वैज्ञानिक विषयों पर लिखना एक सम्मानजनक बात है। उदाहरण के तौर पर, हिंदी में अब पर्यावरण, खगोल, भूगोल, पेट्रोलियम आदि विषयों के शब्द भी आ गए हैं और आ रहे हैं। हिंदी में अरबी, संस्कृत, अंग्रेजी, सभी शब्द प्रयोग किए जा सकते हैं। प्रो. नज़ीर ने स्वतंत्रता–आंदोलन में हिंदी की भूमिका पर भी प्रकाश डाला। उन्होंने सभी को प्रेरित किया कि हिंदी में मौलिक लेखन के साथ–साथ अनुवाद भी किया जाना चाहिए और इस बात को रेखांकित किया कि द्विभाषिकता की स्थिति बनी रहनी चाहिए। उन्होंने राजभाषा संबंधी उपबंधों को भी उद्धृत करते हुए कहा कि रबर की मोहरें, नाम–पट्ट, वेबसाइट, ई–मेल आदि सभी हिंदी / द्विभाषी होने चाहिएँ। इसके अतिरिक्त कंप्यूटर पर भी हिंदी में कार्य करने पर जोर देते हुए प्रो. नज़ीर ने कहा कि यदि ऐसा नहीं करेंगे तो हम पिछड जाएंगे। हमें अपनी भाषा को गौरव के साथ स्वीकार करना चाहिए।

समारोह का संचालन करते हुए संस्थान के राजभाषा अनुभाग के प्रभारी डॉ. दिनेश चंद्र चमोला ने कहा कि सरकारी हिंदी में अनुवाद की प्रमुखता है जबकि दैनंदिन व्यवहार में नैसर्गिक भाषा का प्रयोग होता है। ज्ञान–विज्ञान में हिंदी का प्रयोग राष्ट्रीय महत्व का कार्य है। अतः मिशन व साधना–भाव से इसका अनुप्रयोग करना हम सभी का दायित्व है। इस प्रकार के व्याख्यान व कार्यशालाएं अनुवाद से मौलिकता की ओर बढ़ने में उत्प्रेरक का कार्य कर सकती हैं। यदि हम व्यक्तिगत स्तर पर हिंदी का अनुप्रयोग शुरू कर दें तो अनुवाद की बैसाखी स्वतः ही हट जाएगी। यही इस प्रकार के आयोजनों का ध्येय है।

9.2 हिंदी माह समारोह / Hindi Month Celebrations

9.2.1 हिंदी माह समापन समारोह, 30 सितंबर, 2014

भारतीय पेट्रोलियम संस्थान, देहरादून में आयोजित हिंदी पखवाड़ा समापन समारोह के अवसर पर **'वैश्विक संदर्भ में हिंदी'** विषय पर मुख्य अतिथि के रूप में अपने विचार व्यक्त करते हुए हिंदी सेवी प्रो. सुरेश चंद्र अग्रवाल 'ऋतुपर्ण' ने हिंदी की वैश्विक यात्रा की शुरुआत मॉरिशस, फिजी, गुयाना, त्रिनिडाड जैसे देशों में भारतीयों को मजदूरों के रूप में भेजे जाने के समय से मानते हुए कहा कि इन लोगों ने अपने अस्तित्व को अपनी भाषा व संस्कृति के संरक्षण से जोड़ा और इसी कारण वहां हिंदी व भारतीय संस्कृति जिंदा है। हिंदी की वैश्विक यात्रा वहीं से शुरू होती है। प्रो. 'ऋतुपर्ण' ने अपनी जडों को मजबूत रखने की आवश्यकता को रेखांकित किया और कहा कि हिंदी के अजस्र प्रवाह को कोई रोक नहीं सकता। अपनी भाषा का लालित्य ही आपके ज्ञान को बढ़ाता है। भाषा की पूरी समझ के लिए उसके सांस्कृतिक आशय को भी समझना आवश्यक है। उन्होंने 'हिंदी दिवस' के साथ 'भारतीय भाषा दिवस' मनाए जाने की भी बात की ताकि हिंदी के साथ–साथ उन भाषाओं का भी व्यावहारिक विकास हो। व्याख्यान के उपरांत प्रो. 'ऋतुपर्ण' ने श्रोताओं के साथ प्रश्नोत्तर में उनकी उत्सुकता को भी शांत किया।

संस्थान के राजभाषा अनुभाग के प्रभारी एवं समारोह के संयोजक डॉ. दिनेश चंद्र चमोला ने कहा कि संस्कारधनी हिंदी जहां ज्ञान–विज्ञान के क्षेत्र में प्रभविष्णुता से पदार्पण कर अपनी राजभाषा की ऐतिहासिक यात्रा का प्रमाण दे रही है, वहीं विश्व के कोने–कोने में अपनी आस्था, संस्कृति, अपनत्व व विशालहृदयता का परिचय दे कर अपना क्षेत्र विस्तारित कर रही है। ज्ञानार्जन हम चाहे अनेक भाषाओं में करें

समारोह के उद्घाटन के प्रतीक दीपक को प्रज्वलित करते हुए प्रो. 'ऋतुपर्ण'।

लेकिन व्यवहार रूप में स्वाभिमान से अपनी भाषा का ही अनुप्रयोग करें। आज हिंदी के पास उपलब्ध समूचा बाजार इसकी जीवंतता व समृद्धि का प्रतीक है। हमें मौलिक रूप से उसके उत्थान में अपना यथासंभव योगदान सुनिश्चित करना चाहिए। ऐसे आयोजन उन संकल्पों को दोहराने की उत्प्रेरक पहल हैं।

डॉ श्रीकांत नानोटी, कार्यकारी निदेशक, भापेसं ने मुख्य अतिथि का स्वागत किया। मुख्य अतिथि ने हिंदी पखवाड़े की प्रतियोगिताओं व शब्द लेखन प्रतियोगिताओं के विजेताओं तथा संस्थान की वेबसाइट के द्विभाषीकरण के लिए कर्मचारियों को पुरस्कार वितरित किए। अंततः प्रशासन नियंत्रक श्री लक्ष्मण सिंह नेगी के धन्यवाद–प्रस्ताव के साथ कार्यक्रम संपन्न हुआ।

9.3 संगोष्ठियाँ / कार्यशालाएँ / Seminars/ Workshops

9.3.1 आंतरिक हिंदी वैज्ञानिक संगोष्ठियाँ

44वीं आंतरिक हिंदी वैज्ञानिक संगोष्ठी, 30 मई, 2014

- संस्थान के राजभाषा अनुभाग द्वारा आयोजित इस त्रैमासिक संगोष्ठी में ये प्रस्तुतियां दी गईं: **'CO_2 पृथक्करण तथा प्रच्छादन हेतु समाकलित दृष्टिकोण (उपागम)'**, डॉ. उमेश कुमार'; **'अपॉर्चुनिटी कच्चे तेल'**, सुश्री रश्मि; **'एस्फॉल्ट रॉक द्वारा बिटुमिन निर्माणः एक अध्ययन'**, कमल कुमार; **'ग्रैफीन ऑक्साइड से जुड़े रूथीनियम त्रिनाभिकीय संकुल द्वारा दृश्य प्रकाश की उपस्थिति में कार्बन–डाइ–ऑक्साइड का मेथेनोल में प्रकाश अपचयन,'** पवन कुमार एवं **'शैवाल से उन्नत जैव ईंधन/ऊर्जा उत्पाद'**, सुश्री जयति त्रिवेदी। कार्यक्रम का संचालन डॉ दिनेश चंद्र चमोला, प्रभारी, राजभाषा अनुभाग ने किया ।

- **45वीं आंतरिक हिंदी वैज्ञानिक संगोष्ठी, 22 अगस्त, 2014**

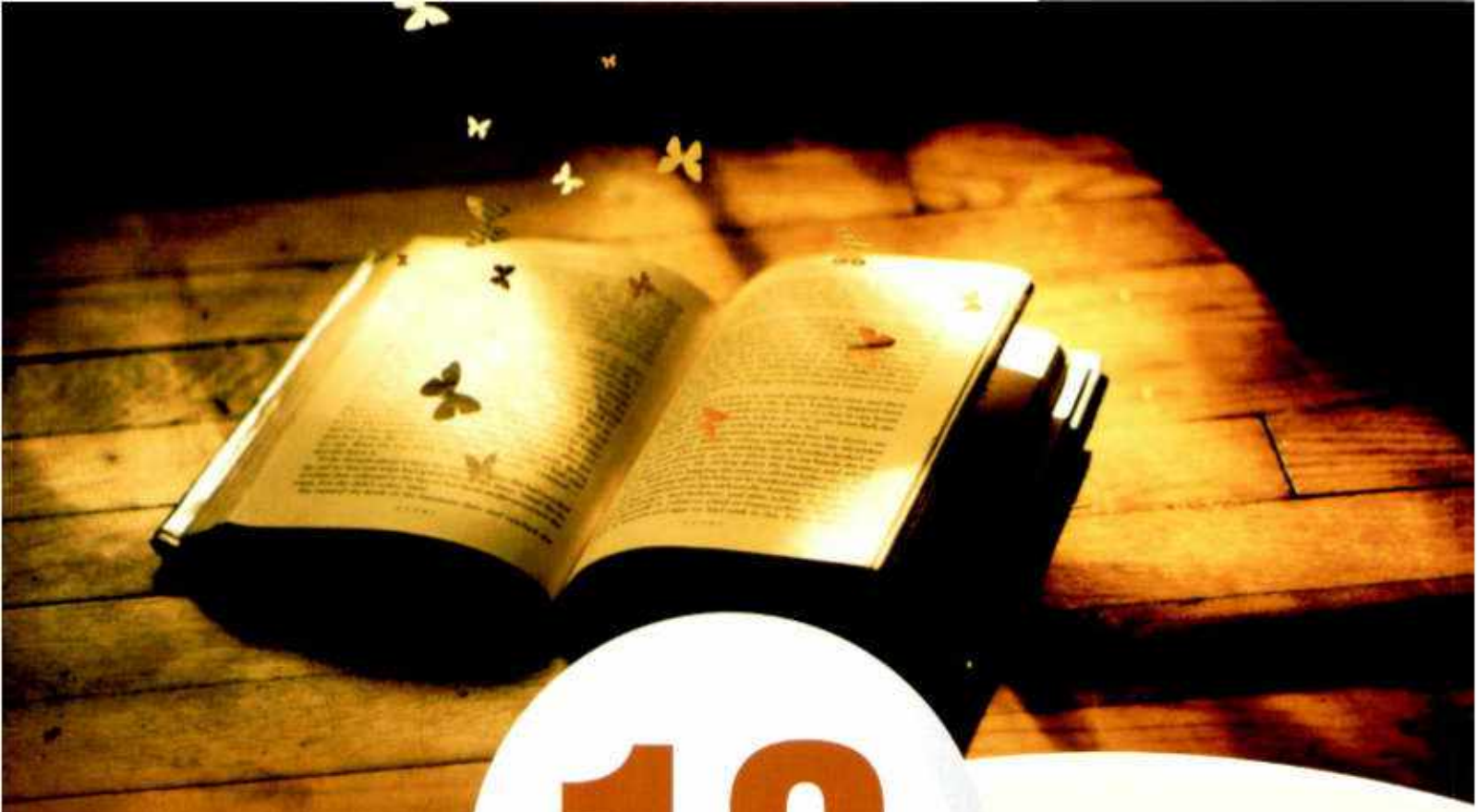
- संस्थान के राजभाषा अनुभाग द्वारा आयोजित इस त्रैमासिक संगोष्ठी में ये प्रस्तुतियां दी गईं: **'विलम्बित कोकन में उत्प्रेरक का प्रयोग एवं प्रभाव'**, डॉ दीपक टंडन; **'मॉन्टे कार्लो अनुकरण तकनीक का प्रयोग कर रॉलिंग कॉन्टैक्ट बेयरिंग के लाभदायक जीवन की प्रागुक्ति (प्रिडिक्शन)'**, ईशान सिंह; **'ग्रैफीनः दशक की अद्भुत सामग्री'**, हर्षल पी. मुंगसे एवं **'जिंक डाइल्किडाइयोफोस्फेट एडिटिव के वातावरण के अनुकूल विकल्प'**, शुभम् पांडेय।

- **46वीं आंतरिक हिंदी वैज्ञानिक संगोष्ठी, 25 नवंबर, 2014**

- संस्थान के राजभाषा अनुभाग द्वारा आयोजित इस त्रैमासिक संगोष्ठी में ये प्रस्तुतियां दी गईं: **'CO_2 के उपयोग से हरित ईंधन'** विषय पर श्री पवन कुमार, **'कोलतार के नवीन उपयोग'** विषय पर डॉ0 उमेश कुमार, **'औषधीय विकास में जैव प्रौद्योगिकी'** विषय पर श्री रोहित रघुवंशी एवं **'बिटुमेन : एक संक्षिप्त परिचय'** विषय पर श्री कमल कुमार द्वारा। इस अवसर पर देश के विभिन्न प्रतिष्ठानों से शिक्षा प्राप्त शोधार्थियों ने भी अपने उद्‌गार व्यक्त किए।

- **47वीं आंतरिक हिंदी वैज्ञानिक संगोष्ठी, 10 मार्च, 2015**

- संस्थान के राजभाषा अनुभाग द्वारा आयोजित इस त्रैमासिक संगोष्ठी में ये प्रस्तुतियां दी गईं: **'स्नेहक योज्यों के प्रकार, मानव स्वास्थ्य तथा पारिस्नेही योज्य'** विषय पर श्री अजिंक्य देशमुख, **'जाइलोज से फ़र्फ़्यूरल में निर्जलीकरण हेतु ठोस अम्ल उत्प्रेरक के रूप में बहुलक संसेचित सल्फोनेटेड कार्बन सम्मिश्र'** विषय पर श्री प्रवीण कुमार खत्री, **'पेट्रो–रासायनिक उद्योग हेतु ऍरोमैटिकः एक प्राथमिक फीड–स्टॉक'** विषय पर श्रीमती निशा एवं **'संधारणीय ग्रामीण विकास हेतु ईंधन दक्ष प्रौद्योगिकियां'** विषय पर श्री पंकज आर्य द्वारा।



10

ए-सीएसआइआर के अंतर्गत संस्थान एक अकादमिक निकाय की भूमिका में

The Institute as an Academic Body under the AcSIR*

* *Academy of Scientific & Innovative Research*

10.1 सीएस्आइआर–भापेसं में सीएस्आइआर–पीजीआरपीई कार्यक्रम/ CSIR-PGRPE Programme at the CSIR-IIP

10.1. विज्ञान में पी–एच्0डी0 कार्यक्रम / PhD Programme in Science

1. **Dr Bhawan Singh**
   Thesis Title: Development of Mesoporous Oxides as Supports and Catalysts for Organic Transformations
   PhD Guide: Dr A K Sinha
   Viva Voce: May 20, 2014

2. **Dr Sanny Verma**
   Thesis Title: Development of New Mehtodologies for Chemical Transformations
   PhD Guide: Dr Suman Lata Jain and Dr Bir Sain
   Viva Voce: August 20, 2014

3. **Dr Bipul Sarkar**
   Thesis Title: Synthesis, Characterization and Activity Studies of Different Supported Nano-clusters
   PhD Guide: Dr Rajaram Bal
   Viva Voce: October 21, 2014

4. **Dr Deepak Verma**
   Thesis Title: Development of Nano-structured Catalysts for New-Generation Fuels and Chemicals
   PhD Guide: Dr A K Shina
   Viva Voce: December 1, 2014

5. **Dr Peta Sreenivasulu**
   Thesis Title: Facile and Green Methods for Synthesis of Nano-porous Nano-Materials for Catalytic Application
   PhD Guide: Dr N Viswanadham
   Viva Voce: December 4, 2014

10.2. एम्0टेक्0 कार्यक्रम/MTech Programme

Following three students completed their MTech in Advanced Petroleum Science and Technology (APST):

1. Mr Krishna Nimesh
2. Ms Garima Mishra
3. Mr Durgaprasad Yedla

Following four students completed their MTech in Advanced Automotive Technology (AAT):

1. Mohd. Asif
2. Mr Eshan Singh
3. Mr Iranna Gogeri
4. Mr Siddarh Singh

11

सीएसआइआर–भापेसं परिवार

THE CSIR-IIP FAMILY

11.1 31 मार्च, 2015 को संस्थान के कर्मचारीगण की स्थिति / CSIR-IIP Staff as on March 31, 2015

11.1.1 वैज्ञानिकगण समूह-IV / SCIENTISTS GROUP-IV

कर्मचारी का नाम / Name of employee	पदनाम / Designation
Dr M O Garg	Director
Dr S M Nanoti	Chief Scientist
Mr B M Shukla	Chief Scientist
Mr Nishan Singh	Chief Scientist
Mr A K Jain	Chief Scientist
Dr Y K Sharma	Chief Scientist
Dr S K Sharma	Chief Scientist
Dr S S Ray	Sr Principal Scientist
Dr (Mrs) Anshu Nanoti	Sr Principal Scientist
Dr Neeraj Athaiya	Sr Principal Scientist
Mr S K Ganguly	Sr Principal Scientist
Mrs Poonam Gupta	Sr Principal Scientist
Dr N Vishwanadham	Principal Scientist
Mr Rajesh Kumar	Principal Scientist
Dr Manoj Srivastava	Principal Scientist
Dr V V D N Prasad	Principal Scientist
Dr Anil Kumar Sinha	Principal Scientist
Dr Samir Kumar Maiti	Principal Scientist
Dr Anil Kumar Jain	Principal Scientist
Dr Shailendra Tripathi	Senior Scientist
Dr P S Verma	Senior Scientist
Dr Thallada Bhaskar	Senior Scientist
Mr Sunil Pathak	Senior Scientist
Dr Sanat Kumar	Senior Scientist
Dr Neeraj Atray	Senior Scientist
Dr Suman Lata Jain	Senior Scientist
Dr O P Khatri	Senior Scientist
Mr Suryadev Kumar	Senior Scientist
Mr L Robindro	Senior Scientist
Mr Devender Singh	Senior Scientist
Mr Wittison Kamei	Scientist
Dr Soumen Dasgupta	Scientist
Dr Rajaram Bal	Scientist
Dr Atul Ranjan	Scientist
Mr G D Thakre	Scientist
Mr Arakshita Mazhi	Scientist
Mr D V Naik	Scientist
Dr Ajay Kumar	Scientist
Mr M K Shukla	Scientist
Mr Swapnil Divekar	Scientist
Mr Sunil Kumar	Scientist
Mr Prasenjit Ghosh	Scientist
Mr Salim Akhtar Farooqi	Scientist
Ms Aarti	Scientist
Dr Babita Behera	Scientist
Dr Debashish Ghosh	Scientist
Mr Pankaj Kumar Kannaujia	Scientist
Mr Deeptarka Dasgupta	Scientist
Ms Bhavya B	Scientist
Dr (Ms) Dipti Agarwal	Scientist
Mr Anand Mohit	Scientist
Mr Sunil Kumar Suman	Scientist
Mr Indrajeet Kumar Ghosh	Scientist
Dr Shubham Paul	Scientist
Dr Umesh Kumar	Scientist
Dr Ankur Bordoloi	Scientist
Mr B Neelam Naidu	Scientist
Ms Jayati Trivedi	Scientist
Mr Pankaj Kumar Arya	Jr. Scientist
Dr Raj Kumar Singh	Jr. Scientist

11.1.2 तकनीकी कर्मचारीगण समूह–III / TECHNICAL STAFF GROUP-III

कर्मचारी का नाम / Name of employee	पदनाम / Designation
Dr (Mrs) Lalita Bakaya	Principal Technical Officer (RMO)
Dr D C Pandey	Principal Technical Officer
Dr R K Chauhan	Principal Technical Officer
Dr Jasvinder Singh	Principal Technical Officer
Mr Anand Singh	Principal Technical Officer
Mr D P Bangwal	Principal Technical Officer
Mr C R Srivastava	Superintending Engineer
Dr Ajay Kumar Gupta	Sr Technical Officer (3)
Dr B R Nautiyal	Sr Technical Officer (3)
Dr Manoj Kumar	Sr Technical Officer (3)
Mr Laxmi Narayan	Sr Technical Officer (3)
Mr M L Sharma II	Sr Technical Officer (3)
Dr K S Rawat	Sr Technical Officer (3)
Mr R C Saxena	Sr Technical Officer (3)
Mr Sarvajeet Singh	Sr Technical Officer (3)
Mr Mahipal	Sr Technical Officer (3)
Mr Hakim Singh	Sr Technical Officer (3)

Mrs Pushpa Gupta	Sr Technical Officer (3)
Mr K K Singh	Sr Technical Officer (3)
Mr Girender Singh	Superintending Engineer
Mr Siya Ram	Sr Technical Officer (3)
Mr G M Bahuguna	Sr Technical Officer (3)
Mr Yog Raj	Superintending Engineer
Mr V S Kukreti	Sr Technical Officer (3)
Mr K P Bhatt	Sr Technical Officer (3)
Mr Ravi Khanna	Sr Technical Officer (3)
Mr Yograj Singh	Sr Technical Officer (2)
Mr Kalyan Singh	Sr Technical Officer (2)
Mr M K S Aloopwan	Sr Technical Officer (2)
Mr D K Pandey	Sr Technical Officer (2)
Mr Hari Chand Singh	Sr Technical Officer (2)
Dr Ghanshyam Thakkar	Sr Technical Officer (2) (RMO)
Mr C D Sharma	Sr Technical Officer (1)
Mr Seth Pal Singh	Sr Technical Officer (1)
Mr Sunil Kumar	Sr Technical Officer (1)
Mr Rakesh Kumar	Sr Technical Officer (1)
Mr Mukesh Kr. Sharma	Assistant Executive Engineer
Mr Sandeep Saran	Sr Technical Officer (1)
Mr Sajid Ahmad Sharif	Sr Technical Officer (1)
Mr Satish Kumar	Sr Technical Officer (1)
Mr Jagdish Kumar	Sr Technical Officer (1)
Mr Manoj Kr. Thapliyal	Sr Technical Officer (1)
Mr Rakesh Kumar Joshi	Sr Technical Officer (1)
Mr Vineet Sood	Sr Technical Officer (1)
Mr Satya Niketan Yadav	Technical Officer
Mr Rajendra Badola	Technical Officer
Mr Sarvanad Tiwari	Assistant Engineer
Mr Amit Sharma	Technical Assistant
Mr Om Prakash Sharma	Technical Assistant
Mrs Nisha	Technical Assistant
Ms Rekha Chauhan	Technical Assistant
Mr Sund Ram Sharma	Technical Assistant
Mr Kamal Kumar	Technical Assistant
Ms Pooja Yadav	Technical Assistant
Ms Jyoti Porwal	Technical Assistant
Mrs Sandhya Jain	Junior Engineer (Gr.I)
Mr Yashveer S. Meena	Technical Assistant
Mr Chandrashekhar P.	Technical Assistant
Mr Praveen Kr. Khatri	Technical Assistant
Mrs Kamla Yadav	Technical Assistant
Ms Manisha Sahai	Technical Assistant
Mr L N S Konthala	Technical Assistant
Mr Piyush Gupta	Technical Assistant
Mr Rohit Kumar	Technical Assistant
Ms Rashmi	Technical Assistant
Mr Pradeep Kumar	Technical Assistant
Mr Raghuvir Singh	Technical Assistant
Mr DeependraTripathi	Technical Assistant
Mr V Bhanu Prasad	Technical Assistant
Ms P Padma Latha	Technical Assistant
Mr Mukesh Kr. Poddar	Technical Assistant
Mr K D P L Kumar	Technical Assistant
Mr Appala N.Chokappu	Technical Assistant
Mr Amit Kumar	Junior Engineer (Gr.I)
Mr Akhilesh Kr. Kurmi	Technical Assistant
Mr Jitendra Kumar	Technical Assistant
Mr Manoj Kumar	Technical Assistant
Mr Gordhan Jain	Junior Engineer (Gr.I)

11.1.3 तकनीकी कर्मचारीगण समूह–II / TECHNICIAN STAFF GROUP-II

कर्मचारी का नाम / Name of employee	पदनाम / Designation
Mr Triloki Prasad	Sr Technician (2)
Mr Mohkam Singh	Sr Technician (2)
Mr Ram Pal Singh	Sr Technician (2)
Mr G C Bahuguna	Sr Technician (2)
Mr V P Mamgain	Sr Technician (2)
Mr Madan Gopal	Sr Technician (2)
Mr T C Sharma	Sr Technician (1)
Mr N N Bahuguna	Sr Technician (1)
Mr Deep Chand	Sr Technician (1)
Mr Harbhajan Singh	Sr Technician (1)
Mr Paramjeet Singh II	Sr. Technician (1)
Mr Rajeev Sharma	Sr. Technician (1)
Mr Rajnish Bhatnagar	Sr. Technician (1)
Mrs Anjali Bhatnagar	Sr. Technician (1)
Mr Anil Kumar	Sr. Technician (1)
Mr Rajpal Singh	Sr. Technician (1))
Mr N K Rawat	Sr. Technician (1)
Mr Ashok Kumar-I	Technician (1)
Mr Ashok Kumar Thakur	Technician (1)
Dr (Mrs) Aruna Kukreti	Technician (1)
Mr Abbal Singh	Technician (1)
Mr Binod Kumar	Technician (1)
Mr Daniel Shah	Technician (1)
Mr Devender Singh Batola	Technician (1)
Mr Gambhir Singh	Technician (1)
Mr Girish Chand Tiwari	Technician (1)

Mr Khem Singh	Technician (1)
Mr Mayank Mishra	Technician (1)
Mr Manmohan Singh Gosain	Technician (1)
Mr Mahendra Singh Negi	Technician (1)
Mr Naseem Ahmed	Technician (1)
Mr Naveen Kumar Maurya	Technician (1)
Dr (Mrs) P Nagendramma	Technician (1)
Mr Puran Singh Aswal	Technician (1)
Mr Pradeep Singh Negi	Technician (1)
Mr Pradeep Singh Panwar	Technician (1)
Mr Parvez Alam	Technician (1)
Mr Pushp Raj Sharma	Technician (1)
Mr Rituraj Singh Negi	Technician (1)
Mr Rajendra Kumar	Technician (1)
Mr Rajeev Panwar	Technician (1)
Mr Rajesh Sharma	Technician (1)
Mr Sanjeev Kumar	Technician (1)
Mr Shiv Prasad Nautiyal	Technician (1)
Dr Sandeep Kumar Saxena	Technician (1)
Dr Indu Shekhar	Technician (1)
Mr Satish Mani	Technician (1)
Mr Tasleem Khan	Technician (1)
Mr Vivek Kumar Sharma	Technician (1)
Mrs Ritu Mourya	Nursing Sister (ANM)/Tech(1)
Mr Hari Prakash	Pharmacist (Non-FCS)
Mr V Silambarsan	Technician (1)
Mr Guru Jothi G	Technician (1)
Mr Ashwani Kuamr	Technician (1)
Mr Jitendra Singh	Technician (1)
Mr Kawle R Koluram	Technician (1)
Mr Amardeep Kumar	Technician (1)
Mr V V Magan Bhai	Technician (1)
Mr Ombir Singh	Technician (1)
Mr Prem Chand Verma	Technician (1)

11.1.4 प्रयोगशाला कर्मचारीगण समूह–I/ LABORATORY STAFF GROUP I

कर्मचारी का नाम / Name of employee	पदनाम / Designation
Mr Vijay Singh	Laboratory Assistant
Mr Ranjeet Singh	Laboratory Assistant
Mr Hari Kishan	Laboratory Assistant
Mrs Maya Gusain	Laboratory Assistant
Mr Balbir Singh I	Laboratory Assistant
Mr Balbir Singh II	Laboratory Assistant
Mr Raj Kumar	Laboratory Assistant
Mr S P Mani	Laboratory Assistant
Mr Mohd Parvej	Laboratory Assistant
Mr Shyam Singh	Laboratory Assistant
Mr Surat Ram	Laboratory Assistant
Mr Mahesh Pal	Laboratory Assistant
Mr Ranbir Singh	Laboratory Assistant
Mrs Dershani Devi	Laboratory Attendant
Mrs Shyam Lata	Laboratory Attendant (2)
Mr Sanjay Kumar	Laboratory Attendant (2)
Mrs Ganga Devi	Laboratory Attendant (2)
Mr Jai Prakash	Laboratory Attendant (2)
Mr S K Verma	Laboratory Attendant (2)
Mr Bharat Singh	Laboratory Attendant (2)
Mrs Kanta Devi	Laboratory Attendant (2)
Mr Dinesh Chandra	Laboratory Attendant (1)
Mr Sunil Kumar	Laboratory Attendant (1)
Mr Naveen Bhatt	Laboratory Attendant (1)
Mr Burhanuddeen	Laboratory Attendant (1)
Mr Hari Singh	Laboratory Attendant (1)
Mr Narendra Singh Negi	Laboratory Attendant (1)
Mr Harold Gladwyn	Laboratory Attendant (1)
Mr Mohan Singh	Laboratory Attendant (1)
Mr Jyoti Prasad	Laboratory Attendant (1)
Mr Sanjay Kumar II	Laboratory Attendant (1)
Mr Shivram Singh	Laboratory Attendant (1)
Mr Rakesh Kumar	Laboratory Attendant (1)
Mr Pradeep Singh Pundir	Laboratory Attendant (1)
Mr Ram Kishore Maurya	Laboratory Attendant (1)

11.1.5 प्रशासनिक कर्मचारीगण/ ADMINISTRATIVE STAFF

11.1.5.1 सामान्य संवर्ग अधिकारीगण/ COMMON CADRE OFFICERS

कर्मचारी का नाम / Name of employee	पदनाम / Designation
Mr Laxman Singh Negi	Controller of Administration
Mr Surender Kumar	Administrative Officer
Mr Suresh Pant	Stores & Purchase Officer
Mr Anil Chandra Gairola	Finance & Accounts Officer
Mr Prsenjit Mitra	Stores & Purchase Officer
Mr Parvesh Chand	Section Officer (General)
Mr Sanjay Rawat	Section Officer (Stores & Purchase)
Mr Rajeev Kumar Verma	Section Officer (General))

Mr Mukesh Kumar Gairola	Section Officer
Mr Shivraj Singh Kushwaha	Section Officer (Stores & Purchase)
Mr C S Bisht	Section Officer (Finance & Accounts)
Mr G N Sundriyal	Section Officer (Finance & Accounts)

11.1.5.2 सहायक ग्रेड–I /ASSISTANTS GRADE-I

कर्मचारी का नाम / Name of employee	पदनाम / Designation
Mr Ramesh Kr. Joshi	Assistant (Gen.) Grade-I (MACP)
Mr D S Negi	Assistant (Gen.) Grade-I (MACP)
Mr R S Chauhan	Assistant (Gen.) Grade-I (MACP)
Mr Vijay Kumar Kataria	Assistant (General) Grade-I
Mrs Vineeta Walia	Assistant (General) Grade-I
Mr Manoj Tiwari	Assistant (General) Grade-I
Mr Arvind Arora	Assistant (General) Grade-I
Mohd Javed	Assistant (General) Grade-I
Mrs Abha Dhyani	Assistant (General) Grade-I
Mr B B Dimri	Assistant (Gen.) Grade-I (MACP)
Mr Vishvendra K Dogra	Assistant (General) Grade-I
Mrs Kiran Lata	Assistant (General) Grade-I
Mr Adesh Seth	Assistant (General) Grade-I
Ms Pratima Bagga	Assistant (General) Grade-I
Mrs Pratima Rana	Assistant (General) Grade-I
Mohd. Farid Ahmad	Assistant (General) Grade-I
Mr Prashant Bhardwaj	Assistant (General) Grade-I
Mrs Anita Devi	Assistant (General) Grade-I
Mrs Sobha Panwar	Assistant (Finance & Accounts) Grade-I
Mr Satish Chand	Assistant (Finance & Accounts) Grade-I
Mrs Seema Sharma	Assistant (Finance & Accounts) Grade-I
Mr Pankaj Mourya	Assistant (Finance & Accounts) Grade-I
Mr Shiv Prasad Saklani	Assistant (Finance & Accounts) Grade-I
Mr Jitendra Singh Negi	Assistant (Finance & Accounts) Grade-I
Mr Mahesh Kr. Jatav	Assistant (Finance & Accounts) Grade-I
Mr L R Kaushik	Assistant (Stores & Purchase) Grade-I
Mr V K Kapoor	Assistant (Stores & Purchase) Grade-I (ACP)
Ms Meena Kumari	Assistant (Stores & Purchase) Grade-I (MACP)
Mr R N Sharma	Assistant (Stores & Purchase) Grade-I
Mr R K Bhattacharya	Assistant (Stores & Purchase) Grade-I
Mr Pramod Joshi	Assistant (Stores & Purchase) Grade-I
Mr Dinesh Chandra	Assistant (Stores & Purchase) Grade-I
Mr Muninder Pal Singh	Assistant (Stores & Purchase) Grade-I

11.1.5.3 सहायक ग्रेड–II/ASSISTANTS GRADE-II

कर्मचारी का नाम / Name of employee	पदनाम / Designation
Mr Jassu Kumar Sharma	Assistant (General) Grade-II
Mr Rakesh Pant	Assistant (General) Grade-II
Mr Sanjay Pokhriyal	Assistant (General) Grade-II
Mr Harjeet Singh	Assistant (General) Grade-II
Mr Kulwant Singh	Assistant (General) Grade-II
Mrs Harvinder Kaur	Assistant (General) Grade-II
Mr Jitendra Singh Rawat	Assistant (General) Grade-II
Mrs Kiran Bala	Assistant (General) Grade-II
Mr Vikram Singh	Assistant (Stores & Purchase) Grade-II
Mrs Asha Joshi	Assistant (Stores & Purchase) Grade-II
Mr Himmat Singh	Assistant (Stores & Purchase) Grade-II
Mr Sunil Rawat	Assistant (Stores & Purchase) Grade-II
Mr Ashish Raturi	Assistant (Finance & Accounts) Grade-II
Mohd. Furkan Saifi	Assistant (Finance & Accounts) Grade-II

11.1.5.4 आशुलिपिकीय संवर्ग के कर्मचारीगण/ STENOGRAPHIC CADRE STAFF

कर्मचारी का नाम / Name of employee	पदनाम / Designation
Mr G P Sharma	Private Secretary
Mr P S Chauhan	Private Secretary
Mrs Geeta Chhetri	Private Secretary
Mr Suresh Kothari	Private Secretary
Mr S C Bhatt	Sr Stenographer (MACP)
Mrs Saroj Kushwaha	Sr Stenographer
Mr Devendra Rai	Sr Stenographer
Ms Reena Sharma	Sr Stenographer
Ms Kusum	Sr Stenographer
Mrs Bhawana Rawat	Sr Stenographer
Mr Rajendra Kumar	Sr Stenographer
Mrs Shaloo Vanodhia	Sr Stenographer
Mrs Padma Kumari S	Sr Stenographer
Mr Navneet Singh Rana	Sr Stenographer

11.1.5.5 एकाकी पद/ISOLATED POSTS

कर्मचारी का नाम/ Name of employee	पदनाम/ Designation
Dr D C Chamola	Sr Hindi Officer
Mr M C Ratori	Sr Hindi Officer
Capt R J Simon	Sr Security Officer
Mr Mohar Singh Nirala	Sr. Technician (1)/Driver
Mr Tajender Singh	Sr. Technician (1)/Driver
Mr G S Mehta	Technician (2)/ Driver
Mr Rajender Prasad	Technician (2)/ Driver
Mr Mukesh Kumar	Technician (2)/ Driver
Mr Govind Singh Rawat	Technician (2)/ Driver

11.1.5.6 जलपानगृह कर्मचारीगण/CANTEEN STAFF

कर्मचारी का नाम/ Name of employee	पदनाम/ Designation
Mr Bharat Singh Bisht	Assistant Halwai-cum-Cook
Mr Lok Bahadur	Tea/Coffee Maker (MACP)
Mr Gopal Singh	Bearer (MACP)
Mr Sudama Singh	Bearer (MACP)
Mr Matbar Singh I	Bearer (MACP)
Mr Matbar Singh II	Bearer (MACP)
Mr Asha Ram	Bearer (MACP)
Mr Munish Kumar	Safai Karmachari (MACP)

11.1.5.7 बहु–कार्य कर्मचारीगण (एमटीएस)/ MULTI-TASKING STAFF (MTS)

कर्मचारी का नाम/ Name of employee	पदनाम/ Designation
Mr Mandev Singh	Junior Security Guard (MACP)
Mr Deepak Kumar	Group C (MTS/MACPS)
Mr K N Sharma	Junior Security Guard (MACP)
Mr B B Ekka	Junior Security Guard (MACP)
Mr Ghanshyam	Group C (MTS/MACPS)
Mr Mukesh Kumar	Group C (MTS/MACPS)
Mr Ram Pal	Group C (MTS/MACPS)
Mr Gopal Singh	Junior Security Guard (MACP)
Mr Rajesh Kumar	Group C (MTS/MACPS)
Mr Dalip Kumar	Safai Karmachari (MACP)
Mr Naresh Kumar	Group C (MTS/MACPS)
Mr Surjeet Thapa	Group C (MTS/MACPS)
Mr Kamal Kumar Sharma	Group C (MACP)
Mr Ajay Pal	Group C (MTS/MACPS)
Mr Dev Singh Adhikari	Group C (MTS/MACPS)
Mrs Bharti Payal	Group C (MTS/MACPS)
Mr Hemant Kumar Tiwari	Group C (MTS/MACPS)
Mr Bijendra Singh Bisht	Group C (MTS/MACPS)
Mr Sudama Singh	Group C (MTS/MACPS)
Mr Laxman Singh Rawat	Group C (MTS/MACPS)
Mr Rajbeer Singh	Group C (MTS/MACPS)
Mr Amit Upadhyay	Group C (MTS/MACPS)
Mr Ramesh Chandra	Group C (MTS/MACPS)
Mr Shiv Singh Rawat	Group C (MTS/MACPS)
Mr Ajay Paul	Group C (MTS/MACPS)
Mr Pankaj Bhaskar	Group C (MTS/MACPS)
Mr Murlidhar Chandna	Group C (MTS/MACPS)
Mr Tika Ram Bhatt	Group C (MTS/MACPS)
Mr Vikram Singh Kandari	Group C (MTS/MACPS)
Mr Vishwas Kumar	Group C (MTS/MACPS)
Mr Rajesh Kumar	Group C (MTS/MACPS)
Mr Manoj Kumar	Group C (MTS/MACPS)
Mr Sanjay Kumar-I	Group C (MTS/MACPS)
Mrs Yashoda	Group C (MTS/MACPS)
Mr Rajendra Prasad	Group C (MTS/MACPS)
Mr Kalu Ram	Group C (MTS/MACPS)
Mr Rajendra Pd. Dabral	Group C (MTS/MACPS)
Mr Mannu Ram	Group C (MTS/MACPS)
Mr Irshad Khan	Group C (MTS/MACPS)
Mr Suresh Kumar	Group C (MTS/MACPS)
Mr Kedar Dutt Pandey	Group C (MTS/MACPS)
Mr Gokul Prasad	Group C (MTS/MACPS)
Mr Vivek Singh	Group C (MTS/MACPS)
Mr Harish Kumar	Group C (MTS/MACPS)
Mr Bijendra Dutt	Group C (MTS/MACPS)
Mr Ghanshyam	Group C (MTS/MACPS)
Mr Rajesh-II	Group C (MTS/MACPS)
Mr Tanveer Ahmad	Group C (MTS/MACPS)
Mr Vijay Kumar Verma	Group C (MTS/MACPS)
Mr Sanjay-III	Group C (MTS/MACPS)
Mr Tilak Kumar	Group C (MTS/MACPS)
Ms Sarveshvari Devi	Group C (MTS/MACPS)
Mr Kamal Singh	Group C (MTS/MACPS)
Mrs Shyamkali	Group C (MTS/MACPS)
Mr Mukesh Kumar	Group C (MTS/MACPS)
Mr Chander Singh	Group C (MTS/MACPS)
Mr Kishore Kumar	Group C (MTS/MACPS)
Mr Surender Kumar	Group C (MTS/MACPS)
Mr Rajesh Kumar	Group C (MTS/MACPS)
Mr Arvind Khandoori	Group C (MTS/MACPS)
Mrs Sureshi Rawat	Group-C (Chair Caner)
Mr Ramchandra	Group C (MTS)
Mr Suresh Chand	Group-C (MTS)
Mr G B Khatri	Group-C (MTS)
Mr Mukul Kumar Sharma	Group-C (MTS)
Mr D S Pundir	Group-C (MTS)
Mrs Uma Devi	Group-C (MTS)
Mr Satish Kumar	Group C (MTS/MACPS)

11.2 वर्ष के दौरान हुई पदोन्नतियाँ/PROMOTIONS DURING THE YEAR

(इसमें सद्यः कार्यरत एवं सेवानिवृत्त दोनों प्रकार के कर्मचारी सम्मिलित हैं /
Includes both who are on the rolls at present & those who have retired)

क्रम सं./ S.No.	नाम / Name	पदोन्नति के बाद पदनाम / Designation upon Promotion	पदोन्नति की तिथि / Date of Promotion
1	Dr R K Chauhan	Principal Technical Officer	02.06.2011
2	Dr D C Pandey	Principal Technical Officer	02.06.2011
3	Mr Ananad Singh	Principal Technical Officer	18.07.2011
4	Mr D P Bangwal	Principal Technical Officer	18.07.2011
5	Dr Jasvinder Singh	Principal Technical Officer	08.08.2011
6	Mr Babulal (Rt.)	Principal Technical Officer	01.02.2008
7	Mr K K Mittal (Rt.)	Principal Technical Officer	01.02.2009
8	Mr K P Bhatt	Sr. Technical Officer (3)	18.08.2011
9	Mr Ravi Khanna	Sr. Technical Officer (3)	19.08.2011
10	Mr Manmohan Kumar (Rt.)	Sr. Technical Officer (3)	19.08.2011
11	Mr Vineet Sood	Sr. Technical Officer (1)	10.03.2010
12	Mr Sarvanand Tiwari	Technical Officer	10.06.2011
13	Mr Rajnish Bhatnagar	Sr Technician (1)	09.04.2011
14	Mrs Anjali Bhatnagar	Sr Technician (1)	09.04.2011
15	Mr Anil Kumar	Sr Technician (1)	15.04.2011
16	Mr Rajpal Singh	Sr Technician (1)	17.04.2011
17	Mr N K Rawat	Sr Technician (1)	29.01.2012
18	Mr Bharat Singh	Lab Attendant (2)	01.01.2006
19	Mr Satish Kumar	Lab Attendant (2)	01.01.2006
20	Mrs Kanta Devi	Lab Attendant (2)	01.01.2006
21	Mrs Anita Devi	Assistant (G) Gr. I	01.09.2014
22	Mr Naveent Rana	Sr. Stenographer	18.07.2014
23	Mr Suresh Kothari	Private Secretary	28.11.2014
24	Mrs Geeta Chhetri	Private Secretary	28.11.2014
25	Mrs Vineeta Waliya	Assistant Gr. I (MACP)	03.05.2014
26	Mr Vijay Kumar Katariya	Assistant Gr. I (MACP)	10.05.2014
27	Mr Arvind Arora	Assistant Gr. I (MACP)	17.05.2014
28	Mrs Shobha Panwar	Assistant Gr. I (MACP)	27.08.2014
29	Mr Hari Singh	Jr. Sec. Guard (MACP)	01.09.2008
30	Mr Ajay Pal	Group C (MTS/MACPS)	03.08.2011
31	Mr Dev Singh Adhikari	Group C (MTS/MACPS)	03.08.2011
32	Mrs Bharti Payal	Group C (MTS/MACPS)	03.08.2011
33	Mr Sanjay Kumar	Group C (MTS/MACPS)	03.08.2011

34	Mr Hemant Kumar Tiwari	Group C (MTS/MACPS)	03.08.2011
35	Mr Bijendra Singh Bisht	Group C (MTS/MACPS)	03.08.2011
36	Mr Sudama Singh	Group C (MTS/MACPS)	03.08.2011
37	Mr Laxman Singh Rawat	Group C (MTS/MACPS)	03.08.2011
38	Mr Rajbeer Singh Negi	Group C (MTS/MACPS)	03.08.2011
39	Mr Amit Upadhyay	Group C (MTS/MACPS)	03.08.2011
40	Mr Ramesh Chandra	Group C (MTS/MACPS)	03.08.2011
41	Mr Shiv Singh Rawat	Group C (MTS/MACPS)	03.08.2011
42	Mr Ajay Paul	Group C (MTS/MACPS)	03.08.2011
43	Mr Pankaj Bhaskar	Group C (MTS/MACPS)	03.08.2011
44	Mr Murlidhar Chandna	Group C (MTS/MACPS)	03.08.2011
45	Mr Tika Ram Bhatt	Group C (MTS/MACPS)	03.08.2011
46	Mr Vikram Singh Kandari	Group C (MTS/MACPS)	03.08.2011
47	Mr Vishwas Kumar	Group C (MTS/MACPS)	03.08.2011
48	Mr Rajesh Kumar	Group C (MTS/MACPS)	03.08.2011
49	Mr Manoj Kumar	Group C (MTS/MACPS)	03.08.2011
50	Mrs Yashoda	Group C (MTS/MACPS)	03.08.2011
51	Mr Rajendra Prasad	Group C (MTS/MACPS)	03.08.2011
52	Mr Kalu Ram	Group C (MTS/MACPS)	03.08.2011
53	Mr Rajendra Prasad Dabral	Group C (MTS/MACPS)	03.08.2011
54	Mr Mannu Ram	Group C (MTS/MACPS)	03.08.2011
55	Mr Irshad Khan	Group C (MTS/MACPS)	03.08.2011
56	Mr Suresh Kumar	Group C (MTS/MACPS)	03.08.2011
57	Mr Kedar Dutt Pandey	Group C (MTS/MACPS)	03.08.2011
58	Mr Gokul Prasad	Group C (MTS/MACPS)	03.08.2011
59	Mr Vivek Singh	Group C (MTS/MACPS)	03.08.2011
60	Mr Harish Kumar	Group C (MTS/MACPS)	03.08.2011
61	Mr Bijendra Dutt	Group C (MTS/MACPS)	03.08.2011
62	Mr Ghanshyam	Group C (MTS/MACPS)	03.08.2011
63	Mr Rajesh	Group C (MTS/MACPS)	03.08.2011
64	Mr Tanveer Ahmed	Group C (MTS/MACPS)	03.08.2011
65	Mrs Darshani Devi	Lab Assistant (II) (MACPS)	03.08.2011
66	Mr Adesh Seth	Assistant (G) Gr. I	01.04.2014
67	Mrs Partima Bhagga	Assistant (G)Gr. I	01.04.2014
68	Mr Munider Pal Singh Arora	Assistant (S&P) Gr. I	01.04.2014
69	Mrs Saroj Kushwaha	Sr Stenographer (MACP)	23.05.2014
70	Mr Tilak Kumar	Group C (MTS/MACPS)	06.01.2015
71	Mr Sanjay	Group C (MTS/MACPS)	06.01.2015
72	Mr Vijay Kumar Verma	Group C (MTS/MACPS)	06.01.2015
73	Mr Manoj Tiwari	Assistant Gr. I (MACP)	31.01.2015

11.3 नए पदधारी/NEW INCUMBENTS

11.3.1 हमारी सहोदरी प्रयोगशालाओं / संस्थानों से नवागत कर्मचारी / New Entrants From Our Sister Laboratories/Institutes

क्रम सं./ S.No.	नाम / Name	पदनाम / Designation	तिथि / Date	कहां से स्थानांतरित / Transferred from
1	Mr Govardhan Jain	Technical Assistant	02.06.2014	CSIR-CERRI, Pilani
2	Mr G N Sundriyal	Account Officer	08.09.2014	CSIR HQ, New Delhi
3	Mrs Darshani Devi	Lab Attendant (2)	01.09.2014	CSIR-CSIO, Chandigarh
4	Mr Prasen Jeet Mitra	Store & Purchase Officer	22.12.2014	CSIR-CDRI, Lucknow

11.4 जो हमसे विदा हुए/ Those Who Have Left Us

11.4.1 अन्य वैऔअप प्रयोगशालाओं / संस्थानों को स्थानांतरण होने पर/ On Transfer to Other CSIR Laboratories/Institutes

क्रम सं./ S.No.	नाम / Name	पदनाम / Designation	तिथि / Date	कहां से स्थानांतरित / Transferred from
1	Dr T V Rao	Principal Scientist	17.04.2014	CSIR-IICT, Hyderabad
2	Mr Prasoon Kumar	Section Officer (General)	16.12.2014	CSIR-IGIB, New Delhi
3	Mr Parvesh Chand	Section Officer (General)	31.03.2015	CSIR HQ, New Delhi
4	Mr Rajeev Kumar Verma	Section Officer (General)	31.03.2015	CSIR-NBRI, Lucknow

11.4.2 अधिवर्षिता / स्वैच्छिक सेवा–निवृत्ति / त्याग–पत्र के कारण / ON SUPERANNUATION /VOLUNTARY RETIREMENT/ RESIGNATION

क्रम सं./ S.No.	नाम / Name	पदनाम / Designation	तिथि / Date	कहां से स्थानांतरित / Transferred from
1	Dr D K Adhikari	Chief Scientist	30.04.2014	Superannuation
2	Mr M S Negi	Assistant I	31.08.2014	Superannuation
3	Mr P C Joshi	Principal Scientist	30.11.2014	Superannuation
4	Dr S K Singhal	Chief Scientist	31.01.2015	Superannuation
5	Dr Savita Kaul	Principal Scientist	28.02.2015	Superannuation
6	Mr H K Sahi	Sr Technician	28.02.2015	Superannuation
7	Mr B M Shukla	Chief Scientist	31.03.2015	Superannuation
8	Dr Neeraj Athaiya	Senior Principal Scientist	31.03.2015	Superannuation
9	Mr Prashant Bahuguna	Assistant (S&P) Gr-I	03.01.2015	Resignation
10	Mr Srinivas Halavath	Technical Assistant	06.02.2015	Resignation

सीएसआइआर–भारतीय पेट्रोलियम संस्थान, देहरादून
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CSIR-Indian Institute of Petroleum, Dehradun
(Council of Scientific and Industrial Research)