वार्षिक प्रतिवेदन
ANNUAL REPORT
1990-91

भारतीय पेट्रोलियम संस्थान, देहरादून

INDIAN INSTITUTE OF PETROLEUM DEHRA DUN-248 005 INDIA

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DEHRADUN

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वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

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FRONT COVER :
depicts the designer's view point on the development of indigenous bimetallic reforming catalyst for improving the octane number and produce aromatics (Benzene, Toluene and Xylenes)

BACK COVER :
shows the joint collaboration of IIP and IPCL for development and production of reforming catalyst and its industrial application at IPCL Vadodara and MRL Madras. Also shows the linkages and support of Centre for High Technology, New Delhi, in commercialisation of this catalyst in MRL reformer

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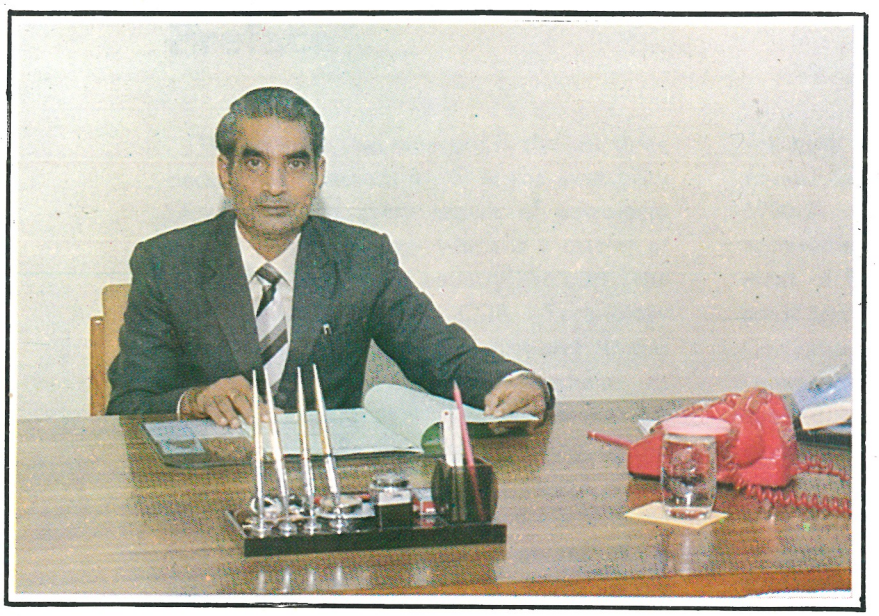
Contents



A Change at the Helm

Dr T S R Prasada Rao took over as Director of the Indian Institute of Petroleum, (IIP) Dehra Dun, on September 20, 1990 from Mr Sudhir Singhal, Deputy Director, who was officiating as Acting Director since October 1988.

Prior to joining the IIP, Dr Prasada Rao was Head of the Research and Development Centre of Indian Petrochemicals Corporation Limited (IPCL) as Deputy General Manager.

Dr Prasada Rao, born on January 20, 1939 obtained his doctorate degree in Inorganic Chemistry from Andhra University, Visakhapatnam, in 1968 and subsequently worked as a senior scientist at Projects and Development India Limited, Sindri. He moved over to IPCL Research Centre in 1974 where he occupied various important positions.

Dr Prasada Rao is an internationally known scientist in the area of catalysis and a reputed research manager. As a champion of collaborative research, some of his major contributions to science and technology in India relate to catalysts and processes for naphtha reforming and xylene isomerisation. He is primarily instrumental in IPCL entering into the business of catalysts and adsorbents. His areas of professional interest are oxidation and ammoxidation of hydrocarbons, catalytic reforming, isomerisation, dehydrogenation, zeolite catalysis and adsorption, hydrotreating and other related aspects. He is widely travelled and has actively participated in many national and international conferences. He has about 60 publications to his credit in national and international scientific journals.

Dr Prasada Rao is on the Editorial Board of the prestigious international journal, **"Applied Catalysis".** He is member of many professional bodies and is a founder member of the Catalysis Society of India and currently its Secretary.

Dr. S.D. Bhagat
Editor

Preface

The strength that emerged in the last three decades of existance of IIP is the availability of expertise in every aspect of petroleum science and technology which is a matter of pride for a developing country like ours. The very fact that the first CSIR Technology Award was bagged by our Institute in this year 1990-91 for the development of Aromatic Extraction Technology amply demonstrates the inherent capability of the institute. Now the future should be in the direction leading to newer and innovative technologies while continuing our effort to apply the existing technologies more appropriately to our present needs of petroleum and petrochemical industry. We have to consolidate and regroup our talents towards achieving these objectives if IIP has to retain its supremacy. There is also a greater need for more extensive and fruitful interaction with the industry while simultaneously pursuing excellence in science.

I have great pleasure in presenting the Annual Report of the Institute for the year 1990-91. Some of the most significant achievements in this year like the development of Bimetallic Catalyst for reforming in collaboration with Indian Petrochemicals Corporation Ltd., (IPCL), Vadodara and its commercialisation at Madras Refineries Limited, Madras and IPCL, Vadodara and the development of technology for the production of Aviation Turbine Fuel (ATF) jointly with Engineers India Limited, Delhi and Hindustan Petroleum Corporation Ltd., Bombay are indicators for another leap in achieving technological excellence. With these achievements on one side and the future challenges of the coming decade on other side, we again pledge ourselves to achieve higher goals in the years to come.

Dr T S R Prasada Rao
Director

भारतीय पेट्रोलियम संस्थान का वार्षिक-प्रतिवेदन

सारांश

संस्थान के सभी अनुसंधान व विकास कार्यक्रमों को और अधिक प्रभावी और युक्तिसंगत रुप से कार्यान्वित करने के एक मात्र उद्देश्य को लेकर, चार मुख्य अनुसंधान क्षेत्रों के अन्तर्गत समाहित किया गया है- पेट्रलियम परिष्करण प्रौद्योगिकी, पेट्रोलियम उत्पाद अनुप्रयोग, रसायन और मध्यवर्ती रसायन और पेट्रोलियम जैव प्रौद्योगिकी। वर्ष 1990-91 की अवधि के दौरान संस्थान के कुछ मुख्य कार्यकलापों और उपलब्धियों की मुख्य बातें यहां दी गयी हैं।

इस अवधि के दौरान संस्थान ने पेट्रोलियम परिष्करण प्रौद्योगिकी के क्षेत्र में उल्लेखनीय उपलब्धियाँ हासिल की है और महत्वपूर्ण क्षेत्रों में विभिन्न उद्योगों को जानकारी भी यह संस्थान हस्तांतरित कर सका है। आई.पी.सी.एल. के सहयोग से भारतीय पेट्रोलियम संस्थान ने तत्सम्बन्धी प्रौद्योगिकी का एक प्लैटिनम-ऋीहिनियम (Pt-Re)द्विधातुक सुधारक उत्प्रेरक विकसित किया है, जो कि उत्प्रेरक विकास प्रौद्योगिकी में एक महत्वपूर्ण उपलब्धि है और जिस पर अब तक बहुराष्ट्रीय निगमों का ही एकाधिकार था। यह देश में विकसित की गयी अकेली सबसे बड़ी उत्प्रेरक प्रौद्यगिकी है। इस उत्प्रेरक का सफलतापूर्वक व्यापारीकरण हो चुका है और उसका मद्रास रिफाइनरीज लिमिटेड और इन्डियन पेट्रोकेमिकल्स लिमिटेड बड़ौदा के सुधारकों (सुधारक संयंत्रों) में इस समय दोहन किया जा रहा है। इन सुधारक संयंत्रों की क्षमता क्रमशः 90,000 व 1,10,000 टन प्रति वर्ष है, जिन में 6.2 व 6.8 टन का उत्प्रेरक-भार है।

उत्प्रेरकीय सुधार हेतु आई.आई.पी., आई.-एफ.पी. की प्रौद्योगिकी को भारतीय तेल निगम के डिगबॉय और बरौनी-स्थित तेल शोधक कारखानों में नए सुधारक संयंत्रों की स्थापना के लिए स्वीकृत कर लिया गया है। उत्प्रेरकीय सुधार हेतु सतत उत्प्रेरक पुर्नज्नन प्रौद्योगिकी (आई.आई.पी.-आई.-एफ.पी.) को भी भारतीय तेल निगम के मथुरा स्थित तेल शोधक कारखाने में एक नया सुधारक संयंत्र लगाने के लिए प्रस्तावित किया गया है।

संदर्भ व्यापारिक सी.सी.आर. उत्प्रेरक के मूल्यांकन के लिए प्रयोगात्मक देशक संयंत्र अध्ययन हाथ में लिया गया है और देशी रूप से सी.सी.आर. उत्प्रेरक का विकास भी संभावित है।

टाइटेनिया-वर्धित अक्रिस्टलीय आलंब पर हाइड्रोजनी उत्प्रेरक के निमार्ण की तकनीक का मानकीकरण हो गया है। भा.पे.सं. में तैयार किए गए उत्प्रेरकों पर आदर्श हाइड्रोकार्बनों के हाइड्रो-भंजन से संबंधित अध्ययन चल रहा है

तरल उत्प्रेरकीय भंजन (एफ.सी.सी.) के क्षेत्र में भी एक नई पहल की गयी है। एफ.सी.सी. उत्प्रेरक सूत्रण के लिए उष्णजलीय रूप से विअल्यूमिनीकृत (गामा) जीओलाइट के नमूने सिलिका-एल्यूमिना मैट्रिक्स में समाविष्ट करने के लिए तैयार किए गए। उत्पादन के इष्टतमीकरण हेतु मथुरा तेल शोधक कारखाने के भरण-सामान पर अनुरूपण अध्ययन किए गए। इन अध्ययनों के परिणामों का वास्तविक तेलशोधक उत्पादन आकंड़ो से अच्छा साम्य रहा। उत्पाद स्लेट, भंजन और निष्क्रियकरण गति के स्थिरांकों के निर्धारण के लिए दो विभिन्न जीओलाइट नमूनों का एन-पैराफिनों की भंजन प्रक्रिया पर अध्ययन किया गया। एफ.सी.सी. उत्प्रेरक की नई किस्म को तैयार करने के लिए सोडियम-वाई (Na Y-Zeolite) जीओलाइट के विअल्यूमिनीकरण के लिए भी प्रौद्योगिकी विकसित की जा चुकी है।

एक आयतित उत्प्रेरक (परिवर्तित जीओलाइट - यू के-30) पर निम्न आक्टेन पैराफिनों के उच्च-आक्टेन उत्पादों में रूपान्तरण के अध्ययन के ऐरोमैटिकों (सुरभितों) के प्रति उच्च वरण क्षमता दिखाई किन्तु क्षीण उत्प्रेरक स्थायित्व की समस्या हुई जिसे जांचा जा रहा है।

तापांतरण प्रक्रियाओं के अंतर्गत खाड़ी तेल अवशेषों पर सिक्तन श्यानताभंजन कार्य और विभिन्न प्रक्रिया चरांकों के साथ कुण्डली-श्यानता भंजन पर परीक्षात्मक प्रयोग मथुरा रिफाइपरी अवशेष पर पूरे किए जा चुके हैं।

तेल शोधक कारखानों की गैसों से होने वाले पर्यावरण प्रदूषण को रोकने के लिए तदनुकूल

उत्प्रेरक के विकास द्वारा विगंधकीकरण पर एक सहयोगात्मक प्रयास की आशा है।

अप्रचिलित ओलियम प्रौद्योगिकी के स्थान पर भोज्य श्रेणी हैक्सन पैदा करने वाली विलायक निष्कर्षण प्रौद्योगिकी विकसित की गयी है। इस हेक्सेन के उत्पादन के लिए जून 1990 से आई.आई.पी./ई.आई.एल. निष्कर्षण प्रौद्योगिकी पर आधारित 25,000 टन प्रति वर्ष क्षमता का एक संयंत्र भारतीय पेट्रोलियम कारपोरेशन लि. बम्बई में कार्य कर रहा है। आई.आई.पी. व ई.आई.एल. ने अगस्त 1990 में गारंटी प्रयोग संतोषजनक ढंग से निपटा लिए थे। एक समान क्षमता की इकाई मद्रास रिफाइनरीज लि. में तैयार की जा रही है। इसके अतिरिक्त एक नए विलायक - एन.एम.पी. के साथ निष्कर्षण के द्वारा एफ.जी. हेक्सेन उत्पादन के लिए प्रौद्योगिकी विकास कार्य चल रहा है। निचित स्तम्भ पर सतत प्रति प्रवाह निष्कर्षण प्रयोगों के द्वारा अपरिष्कृत-हेक्सेन एन.एम.पी. + जल प्रणाली पर आधारभूत एल.एल.ई. आंकड़े तैयार कर लिए गए हैं। साथ ही हिन्दुस्तान पेट्रोलियम कारपोरेशन लि. बम्बई के देशक संयंत्र पर "स्केल-अप" आंकड़े इकट्ठे किए गए। विलायक निष्कर्षण द्वारा ए.टी.एफ. के उत्पादन के लिए आई.आई.पी., ई.आई.एल. और एच.पी. सी.एल. द्वारा संयुक्त रूप से विकसित की जा रही प्रौद्यगिकी का प्रदर्शन एच.पी.सी.एल. बम्बई के देशक संयंत्र पर इन्डियन आयल कारपोरेशन-असम आयल डिविजन के सामने किया गया।

नैफथा और केरोसीन एक साथ वि-ऐरोमैटन के लिए परीक्षण किए गए और "यूनीफैक" विलयन प्रोरूप के प्रयोग से प्राप्त निर्ष्कषों का सहसम्बंध स्थापित किया गया।

गुणवत्ता में श्रेष्ठ ल्यूब आधारित संभारों के निर्माण के लिए पूर्वजलविवेचित अपरिष्कृत आसुतों तथा अपरिष्कृत ल्यूब आसुतों एवं डीएसफाल्टेड ऑयल (डी.ए.ओ.) पर एन.एम.पी. तथा फरफ्यूरल के साथ विलायक निष्कर्षण प्रयोग किए गए।

विभिन्न संभारों से पैराफिन मोम की किस्मों के उत्पादन के लिए उच्च प्रौद्योगिकी केन्द्र (सेन्टर फार हाइटैक्नालॉजी) की पहल पर सुसंगति व प्रक्रिया इष्टतमीकरण अध्ययन की शुरूआत की गयी।

भारत में पहली बार भा.पे.सं. ने द्रव झिल्ली के प्रयोग से हाइड्रोकार्बन किस्मों के पृथक्करण पर अध्ययनों की शुरूआत की है। यह प्रौद्योगिकी क्योंकि परिवेश ताप पर प्रचलित की जाती है, इसलिए विलायक निष्कर्षण की अपेक्षा अधिक ऊर्जा बचाती है। द्रव-झिल्लियों के माध्यम से ऐरोमैटिकों (सुरभितों) के पृथक्करण का एक प्रवाह चित्र विकसित किया गया और तकनीकी आर्थिक सुसंगति की रिपोर्ट बनाई गयी।

विभिन्न परिस्थितियों के अन्तर्गत द्रव-झिल्ली निष्कर्षण के माध्यम से बहिस्रावी धारा से फीनॉइलों के विलमन के लिए समूह-परीक्षणों का अध्ययन किया गया। द्रव-झिल्ली पृथक्करण पर एक तत्सम्बन्धी प्रौद्योगिकी रिपोर्ट एक प्रायोजक के लिए तैयार की गयी।

कच्चा तेल और उत्पादों के मूल्यांकन के क्षेत्र में उल्लेखनीय प्रगति हुई है। उत्तरी गुजरात, डिगबॉय आसाम (मिश्र) एव गोदावरी अपतटीय कच्चे तेल मुख्य अंशों की उत्पाद-संभावना व गुणवत्ता का मूल्यांकन किया गया। जाइलीन उत्पादन के लिए बाम्बे हाई तेल से प्राप्त नैफथा अंशों का मूल्यांकन किया गया।

विभिन्न परिस्थितियों के अंतगर्त रत्ना और बोरहोला कच्चे तेलों का मोम-निक्षेपण व्यवहार परखा गया।

भारी एल्कीलेट तलावशेषों के अभिलक्षण और तेल-विलेय सल्फानेट भरण सामान के विनिर्देशन के विकास के लिए लुब्रिजाल इन्डिया के द्वारा प्रायोजित कार्या पूरा कर लिया गया है। विश्लेषणों के आधार पर एच.ए.बी. के लिए एक प्रारम्भिक विनर्देशन आरेखित कर लिया गया है।

पेट्रोलियम उत्पाद अनुप्रयोग के क्षेत्र में, दो-स्ट्रोकी इंजिनों पर उनकी ईंधन-दक्षता में सुधार करने और उत्सर्जन में कमी करने की दृष्टि से बहुत से कार्यक्रम प्रारंभ किए जा रहे हैं। रेचित गैस पुनः संचरण का प्रयोग करते हुए हैती अंतर्ग्रहण इंजिन का एक नया विकल्प विकसित किया जा रहा है। यह विचार रेचित गैस के हाइड्रोकार्बन-प्रचुर अंश को वरणात्मक रूप से इंजित सिलिंडर में पुनः संचारित करने पर आधारित है। पारम्परिक दो-स्ट्रोकी इंजिन में, अनियमित दहन और अविस्फोटन कम कर इसकी

अंश उपरोधी (थ्रॉटल) ईंधन किफायत में सुधार करने के लिए प्रयास आरम्भ किए जा चुके हैं। अविस्फोटन की घटना में सम्मिलित यंत्रावती पर एक विस्तृत अध्ययन पूरा किया गया। दो-स्ट्रोकी इंजिनों पर अन्य मुख्य गतिविधियाँ रही हैं- मोटर साइकिल इंजिनों पर दहन दबाव-समय पृष्ठभूमि का अध्ययन, कार्यक्षेत्र मूल्यांकन के आधार पर दो-स्ट्रोकी इंजिन तेल (2-टी) के सूत्रणों का अध्ययन और 2-टी तेलों के "पूर्वज्वलन" रूझान को मापने-तौलने वाली परीक्षण तकनीकों का विकास।

इंजिन की निष्पादिता (निष्पादन-क्षमता) पर ईंधन गुणवत्ता का क्या असर होता है, इस पर भी अध्ययन किए गए हैं। प्रारम्भिक अध्ययन दुपहिया, वाहनों की आक्टेन की आवश्यकता, गैसोलीन का ऑक्सीकरण स्थायित्व और गैसोलीन इंजिन-स्वच्छता पर इसका असर और डीजल ईंधन गुणतत्ता का नॉजल-कोकन पर प्रभाव देखा गया।

डीजल इंजिन में *शीकर भूंवर* अन्योन्थक्रिया के अनुरुपण के लिए एक गणितीय प्रतिरुप विकसित किया गया था। आयातित इंजिन का स्थान ग्रहण करने के लिए किर्लोस्कर सुपरचार्ज इंजिन पर स्नेहक तेल परीक्षण प्राविधि का देशज विकास चल रहा है। भारतीय और विदेशी ड्राइविंग चक्रों के अनुसार दुपहिया वाहनों और सवारी कारों के सामूहिक उत्सर्जन माप लिए गए। वैकल्पिक ईंधनों के क्षेत्र में 15-20% डीजल का स्थान लेने के उद्देश्य से 25 बसों पर ईथैनॉल से सामूहिक परीक्षण किया जा रहा है।

ट्राइबोलॉजी के अध्ययन के क्षेत्र में विशेष जोर स्नेहक-धातु पारस्परिक क्रिया, चलन में घर्षण, स्नेहक संयोजनों में घर्षण और घर्षण रुपान्तर-कारियों की क्रिया की यंत्रावली से संबंधित मौलिक अध्ययन की ओर रहा है। प्लास्ट्रो-हाइड्रो डाइनैमिक परिस्थितियों के अन्तर्गत घर्षण परीक्षण पूर्ण किए गए। स्नेहकों के रासायनिक अपघटन एंव सतही परत के प्रावस्था रुपान्तरण के घर्षण पर प्रभाव का अध्ययन किया गया।

घरेलू और औद्योगिक प्रयोगों के लिए, बेहतर कार्यक्षमता प्राप्त करने के उद्देश्य से ज्वालकों के विकास पर कार्य चल रहा है।

रसायनों व मध्यवर्ती रसायनों के क्षेत्र में, योजकों एवं विशेषता-रसायनों की दिशा में प्रभावशाली प्रगति की गयी है।

तृतीयक ब्यूटाइल फीनॉल (पी.टी.बी.पी.) के उत्पादन के लिए "तारा ऑइल कैमिकल्स" के साथ प्रौद्योगिकी के हस्तांतरण पर एक समझौते पर हस्ताक्षर हो चुके हैं। उक्त कम्पनी अगले वर्ष तक एक 500 टन प्रतिवर्ष का संयंत्र स्थापित करने वाली है।

ऑक्टिलीकृत डाइफिनिलामीन को तैयार करने के लिए आइसोब्यूटिलीन स्वल्पलकों के प्रयोग से डाइफिनिलामीन के एल्किलेटों का अध्ययन किया गया। मूल्यांकन हेतु एन, एन. डाइ-आइसोप्रोपिल-पैरा-फिनिलीन डाइ-एमीन के नमूने तैयार किए गए और स्थिति-रिपोर्ट भी तैयार कर ली गयी है। ब्यूटिलीकृत हाइड्रोसिनेमिक अम्ल और इसके मिथाइल एस्टरों का संश्लेषण प्राप्त कर लिया गया है।

40-80° से. के तापक्रम में, धनायन-विनिमय रेजिनों को उत्प्रेरक के रूप में प्रयोग कर मीथनॉल के साथ भंजित पेट्रोलियम स्टॉकों में उपस्थित ओलेफिनों के एस्टरीकरण पर मौलिक अध्ययन संचालित किए गए।

मौन क्रिस्टल आकृतिकी के रूप सुधारण के लिए विशिष्ट रसायनों का संश्लेषण और इन उत्पादों के व्यापारिक डीजल में प्रवाह-सुधारक विशेषताओं के लिए इनकी प्रारंभिक जॉच पूरी हो चुकी है। आई.ओ.सी. द्वारा इन योजकों का मूल्यांकन जारी है।

श्वेत तेल/द्रव पैराफिन के लिए एक प्रक्रिया विकसित की गयी है जो कि मौजूदा व्यापारिक प्रक्रिया से कहीं अधिक किफायती है।

बहुत से दीर्घ-श्रंखला एस्टरों और वसायुक्त अम्लों, एल्कोहलों और एल्किलफीनॉल से प्राप्त विभिन्न फॉसफोरस व गंधकयुक्त यौगिकों का निर्माण किया जा रहा है और इनका प्रयोग घर्षण व छीलन कम करने वाले योजकों के रूप में किया जाएगा।

लैटेक्सधर और रालयुक्त पौधों की किस्मों का मूल्यांकन "मैट" इकाई में उनके हाइड्रोकार्बनों में जैवभार परिवर्तन के लिए किया गया। इष्टतमीकृत परिस्थितियों में बहुत से जैव-अशोधित नमूनों का अध्ययन किया गया। जोजोबा तेल के दीर्घ श्रंखला (C18-C24) एल्कोहलों में एक सीढ़ीय परिवर्तन के

लिए प्रक्रिया परिस्थितियों का इष्टतमीकरण किया गया। संक्षारण-निरोधी के रूप में मूल्यांकन किए जाने वाले दीर्घ-श्रंखला जोजोबा एमाइडों के निर्माण के लिए भी अध्ययन शुरु कर दिए गए हैं। "स्नेहक तेलों के सूत्रणों के लिए जोजोबा तेल व उसके व्युत्पन्नों का उपयोग" पर एक प्रतिवेदन तैयार किया जा चुका है।

पेट्रोलियम जैव प्रौद्योगिकी के क्षेत्र में, एक कोशिकीय प्रोटीन और अन्य कार्बन अवस्तरों के उत्पादन के लिए गुज़रात तेलशोधक कारखाने में सन् 1970 से तैयार की गयी प्रयोगशाला व देशक संयंत्र की सुविधायें अप्रैल 1990 में बन्द कर दी गयी थीं। अब भा.पे.सं. देहरादून में प्रयोगशाला की सुविधाऐं तैयार कर ली गयी हैं। यह समूह अब अधिक भारी पेट्रोलियम प्रभाजों के माइक्रोबिअल विमोमन (विसिक्थन) पर कार्य कर रहा है। उद्देश्य ऐसी माइक्रोबाइअल प्रक्रिया को विकसित करने का है जो कि 350-550° से. की श्रेणी में वैक्यूअम (निर्वात) आसुतों के लिए वर्तमान ऊर्जा-गहन विलायक विमोमन प्रक्रिया का स्थान ले सके। इस कार्य का एक अन्य कार्यक्रम, एक-कोशिकीय तेल माइक्रोबइअल लिपिड पर नाइट्रोजन-बंधक परिस्थितियों में किण्वन को दृष्टि में रखता है।

तकनीकी-आर्थिक सुसंगति अध्ययन और बाजार सर्वेक्षण ट्रान्सफार्मर आइल बेस स्टोक/फीड स्टाक (टॉब्स/टॉफस) तर्कु एच- तेलों की मांग की पूर्व सूचना तथा अभियांत्रिकी प्लास्टिकों के क्षेत्र में किये गये।

भा.पे.सं. के अनुसंधान व विकास कार्यक्रमों की गतिविधियों को संरचनात्मक सुविधाओं का सक्रिय सहयोग प्राप्त है। विभिन्न प्रायोजित व गृह परियोजनाओं को वर्णलेखन व स्पेकट्रमिकी तकनीकें जैसे एक्स.आर.डी., एन.एम.आर., जी.सी., एम.एस.यू.वी. आई.आर., ए.ए., ए.ई., और भौतिक-रसायनिकों एवं निश्पादन गुणवत्ता मापनों इत्यादि का संश्लेषणात्मक सहयोग प्राप्त है। बहुत सी विशिष्टीकृत तकनीकों और परीक्षा प्रविधियों का अनुसंधान कार्यक्रमों के लिए विकास किया गया है। समग्र रूप से वर्ष भर की गतिविधियों भविष्य में एक लम्बी छलांग की साक्षी रही हैं।

विभेद :

1990-91 के दौरान विभिन्न एजेन्सियों द्वारा प्रायोजित 23 परियोजनायें पूरी की गयी और इन प्रायोजित परियोजनाओं से रुपये 38.614 लाख की राशि अर्जित की गयी। वर्ष के दौरान कुल समग्र धन प्राप्ति रुपये 1.06 करोड़ थी। यह प्रसन्नता का विषय है कि भा.पे.सं. को सुधारित नैफथा से बैन्जीन, टाल्यूईन और जाइलीन के उत्पादन की एक विलायक निश्कर्षण प्रक्रिया के विकास के लिए "सी.एस.आई.आर. प्रौद्योगिकी पुरस्कार 1990" प्राप्त हुआ है। भा.पे.सं. के छः वैज्ञानिक कर्मियों को उनकी विशेषज्ञता के क्षेत्र में 1990-91 के दौरान पी-एच.डी. उपाधि प्रदान की गयी। एक वैज्ञानिक को रुड़की विश्वविद्यालय से एम.टैक. उपाधि मिली और उन्हें स्वर्ण पदक मिला और दो अन्य वैज्ञानिकों को आई.आई.टी. दिल्ली से एम.टैक. उपाधि मिली।

अन्य गतिविधियाँ :

विभिन्न राष्ट्रीय और अन्तर्राष्ट्रीय पत्रिकाओं में 40 शोधपत्र प्रकाशित हुए, जब कि विभिन्न संगोष्ठियों, परिसंवादों, कार्यशालाओं और गोष्ठियों में 13 शोधपत्र प्रस्तुत किए गए। वर्ष में तीन एकस्व (पेटेन्ट) दाखिल किए गए। पेट्रोलियम और तत्संबंधित उद्योगों से आने वाले तकनीकी कर्मियों को प्रशिक्षण देने के लिए भा.पे.सं. ने 5 प्रशिक्षण कार्यक्रम भी चलाए। कुल मिलाकर इन प्रशिक्षण कार्यक्रमों में 65 कर्मियों ने भाग लिया। इस अवधि के दौरान विभिन्न अंतर्राष्ट्रीय वैज्ञानिक सहयोग कार्यक्रमों के तहत भा.पे.सं. के 7 वैज्ञानिक विदेश में भेजे गए, जब कि विदेश से 5 अग्रणी वैज्ञानिकों ने विभिन्न कार्यक्रमों के तहत संस्थान का दौरा किया। राष्ट्रीय विज्ञान दिवस, सी.एस.आई.आर. स्थापना दिवस और भा.पे.सं. स्थापना दिवस भी इस वर्ष मनाए गए। इन अवसरों पर सुविख्यात वैज्ञानिकों ने भाषण दिए। अन्य गतिविधियाँ थीं– निबंध व "क्विज" (प्रशनोंत्तर) प्रतियोगिताए, अभिकलित्र और अनुरुपण और प्रारुपण का प्रदर्शन। भा.पे.सं. में एक अच्छी गतिविधि यह है कि यहाँ देश व विदेश से आए वैज्ञानिकों से वैज्ञानिक विषयों पर परिसंवाद (कोलोकिया) आयोजित किए जाते हैं और इस अवधि के दौरान 10 भाषण आयोजित किए गए।

Summary

All the R&D programmes of the institute have been covered under four broad research areas (Petroleum Refining Technology, Petroleum Products Application, Chemicals and Intermediates and Petroleum Biotechnology) with the sole objective of implementing the programmes more effectively and rationally. Highlights of some of the important activities and achievements of the institute during the period 1990-91 are given here.

During this period the institute has made significant achievements in the area of *Petroleum Refining Technology* and has been able to transfer know-how to various industries in major thrust areas. IIP, in collaboration with IPCL, has developed a state-of-the-art Pt-Re bimetallic reforming catalyst, a major breakthrough in the catalyst development technology, which had so far been the monopoly of multinationals. This is the single largest catalyst technology developed indigenously. The catalyst has been successfully commercialised and is presently being loaded in the reformers at Madras Refineries Limited (MRL), Madras and IPCL, Baroda, having capacities of 90,000 and 110,000 tpa with catalyst loads of 6.2 and 6.8 tonnes respectively.

The IIP-IFP technology for catalytic reforming has been accepted for putting up new reformers at Indian Oil Corporation (IOC) refineries at Digboi and Barauni. Continuous Catalyst Regeneration (CCR) technology (IIP-IFP) for catalytic reforming has also been offered to IOC Mathura refinery for a new reformer plant. Experimental pilot plant studies for evaluation of reference commercial CCR catalyst have been undertaken and the development of an indigenous CCR catalyst is in progress.

The technique for the preparation of hydrocracking catalyst on titania promoted amorphous support has been standardised. Studies on hydrocracking of model hydrocarbons on catalysts prepared at IIP are in progress.

A novel beginning has also been made in the field of Fluid Catalytic Cracking (FCC). Samples of hydrothermally dealuminated Y-zeolite were prepared for incorporation into silica-alumina matrix for FCC catalyst formulation. Simulation studies with Mathura refinery feed for yield optimization were conducted. The results showed good agreement with the actual refinery yield data. Some studies on cracking of n-paraffins were carried out on two different zeolite samples to determine product slate, cracking and deactivation rate constants. The technology has also been developed for dealumination of Na-Y zeolite for the preparation of new generation of FCC catalysts.

Studies on conversion of low octane paraffins to high octane products over an imported catalyst (modified zeolite UK-30) indicated high selectivity to aromatics but the problem of poor catalyst stability is being looked into.

Under thermal conversion processes, work on soakervisbreaking studies on Persian Gulf short residue and six trial runs on coil visbreaking of Mathura resid feed stock with different process variables have been completed.

A collaboration on desulphurisation of refinery gases by developing tailor-made catalyst to control environmental pollution from refineries is foreseen.

Solvent extraction technology has been developed for the production of food grade hexane to replace the obsolete oleum treatment technology. A 25,000 tpa capacity plant based on IIP-EIL extraction technology is operating at Bharat Petroleum Corporation Limited (BPCL) Bombay since June 1990 for production of food grade hexane. The guarantee runs were satisfactorily performed by IIP and Engineers India Limited (EIL) in August 1990. Another unit having identical capacity is being erected at MRL Madras.

Further development of this technology for production of food grade hexane by extraction with a new solvent-NMP is in progress. Basic liquid-liquid extraction data have been generated on raw hexane-NMP + water system through continuous counter current extraction experiments on packed column, and scale-up data were collected on pilot plant at Hindustan Petroleum Corporation Limited (HPCL), Bombay. The technology being developed jointly by IIP, EIL and HPCL for production of Aviation Turbine Fuel (ATF) by solvent extraction was demonstrated to AOD (IOC) on the pilot plant at HPCL Bombay. Studies were conducted for simultaneous dearomatisation of naphtha and kerosene and the results were correlated by using UNIFAC solution model.

An exhaustive study has been made for solvent extraction of raw lube distillates and deasphalted oil using NMP and furfural as solvents. Solvent extraction studies were also conducted on prehydrotreated raw distillates to make quality lube base stocks.

A feasibility-cum-process optimization study has been undertaken at the instance of Centre for High Technology (CHT) for production of paraffin waxes from different stocks.

For the first time in India, IIP has initiated studies on the separations of hydrocarbon types using liquid membrane. The technology has been found to be more energy efficient than that of solvent extraction, since it is carried out at ambient temperatures. A process flow sheet for separation of aromatics through liquid membranes was developed and final report for techno-economic feasibility issued. Batch experiments for removal of phenols from effluent aqueous streams through liquid membrane extraction were carried out under varying conditions. A state-of-the-art report on liquid membrane separation was prepared for the sponsor.

Significant progress has been made in the areas of crudes and products evaluation. Basic crude characteristics and key properties of broad cuts for product potential and quality were evaluated for North Gujarat, Digboi and Assam mix and Godavari off-shore crudes. Bombay High crude naphtha fractions were evaluated for xylene production.

Wax deposition behaviour of Ratna and Borholla crude has been studied under varied conditions.

The sponsored work from Lubrizol India Ltd. (LIL) for characterisation of heavy alkylate bottoms and development of specification for oil soluble sulphonate feed stock has been completed. Based on analytical investigations, a tentative specification for acceptable heavy alkylate bottoms (HAB) has been drawn.

In the area of *Petroleum Products Application,* various programmes are under way on two-stroke engines with a view to improve their fuel efficiency and reduce emissions. Development of a new concept of dual intake engine using selective exhaust gas recirculation is in progress. The concept is based on recirculating selectively the hydrocarbon rich portion of the exhaust gas in the engine cylinder. In the conventional two-stroke engine, efforts are under way to improve its part throttle fuel economy by reducing irregular combustion and misfiring. A detailed study on the mechanisms involved in the misfiring phenomena was completed. Other major activities in two-stroke engines have been on combustion pressure-time history studies on motor cycle engines, study of two-stroke engine oil (2-T) formulations through field evaluation and development of test techni-ques to assess 'preignition' tendency of 2-T oils.

Studies have also been undertaken on the effect of fuel quality on engine performance. In the first phase, the octane requirement of two-wheelers, oxidation stability of gasoline and its effect on gasoline engine cleanliness, and the effect of diesel fuel quality on nozzle coking were studied.

A mathematical model for simulating the

spray-swirl interaction in a diesel engine was developed. Indigenous development of test method for oil on Kirloskar supercharged engine to replace tests based on imported engine is in progress. Mass emission measurements of two-wheelers and passenger cars, as per Indian and foreign driving cycles, were carried out. In the area of alternative fuels, a fleet trial on 25 buses is now being done with ethanol with an objective to replace 15-20% of diesel.

Under tribological studies, the emphasis has been on basic studies pertaining to lubricant-metal interaction, running-in wear, wear in lubricant contacts and mechanism of action of friction modifiers. Wear investigations under plasto-hydrodynamic conditions were completed. The influence of chemical decomposition of the lubricants and phase transformation of surface layer on wear was studied.

The work on development of burners for domestic and industrial applications with a view to achieve better efficiency is also in progress.

In the area of *Chemicals and Intermediates,* impressive progress has been made in the field of additives and specialty chemicals, and agreement was signed for transfer of technology with Tara Additives and Specialty Fluids Ltd. for production of p-tertiary butyl phenol (PTBP). The party will be putting up a 500 tpa plant by next year. Alkylations of diphenylamine using isobutylene oligomers to prepare octylated diphenylamine were studied. N, N^{1}-Di-isopropyl - p - phenylene - diamine samples were prepared for evaluation and status report was also prepared. Synthesis of butylated hydrocinnamic acid and its methyl esters has been achieved.

Basic studies were conducted on esterification of olefins present in cracked petroleum stocks with methanol using cation-exchange resins as catalyst in the temperature range of 40-80°C.

Syntheses of specific chemicals for modification of wax crystal morphology and preliminary screening of these products for their flow-improver characteristics in commercial diesels were completed. Evaluation of these additives by IOC is in progress.

A process for white oil/liquid paraffin was developed which is more economical than the existing commercial process.

Preparation of several long-chain esters and various phosphorus and sulphur containing compounds derived from fatty acids, alcohols, and alkyl-phenol is under progress and these are to be used as friction and wear reducer additives.

Laticiferous and resinous species were evaluated for their biomass conversion to hydrocarbons in Micro Activity Test unit. A number of biocrude samples were studied under optimised conditions. Reaction conditions were optimised for the single-step conversion of jojoba oil into long chain (C_{18}-C_{24}) alcohols. Studies have also been initiated for the preparation of long chain jojoba amides to be evaluated as corrosion inhibitors. A report was prepared on "Utilisation of jojoba oil and its derivatives for lubricating oil formulations".

In the area of *Petroleum Biotechnology,* the laboratory and the pilot plant facilities created at Gujarat Refinery premises since 1970 for production of single cell protein and other carbon substrates were closed down in April 1990. Laboratory facilities have been created now at IIP Dehradun. The group is now working on microbial dewaxing of heavier petroleum fractions. The aim is to develop a microbial process which can replace the existing energy intensive solvent dewaxing process for vacuum distillates in the range of 350-550°C. Another programme of work envisages fermentation in the nitrogen limiting condition on production of single cell oil microbial lipid.

Techno-economic feasibility studies and market surveys were done for demand forecasting of transformer oil base stocks/transformer oil feed stocks and spindle high viscosity index oils and also in the area of engineering plastics and specialty greases.

During this year also, the activities of IIP's R & D programmes are actively supported by infrastructural facilities. Instrumental techniques provided analytical backup to various sponsored and also to in-house projects through chromatographic and spectroscopic techniques like XRD, NMR, GC, GC-MS, UV, IR, AA, AE etc, and also by carrying out various physico-chemical and performance property measurements. A variety of specialised techniques and test methods have also been developed for various research programmes. On the whole the activities of the year have seen a leap towards future.

Distinctions

Twentythree sponsored projects from various agencies were completed during 1990-91 and a sum of Rs 38.614 lakhs was earned from these sponsored projects. The total gross money receipt during the year was Rs 1.06 crores. It is a matter of pleasure that the **IIP was awarded "CSIR Technology Award 1990"** for development of a solvent extraction process for production of benzene, toluene and xylene from reformed naphtha. Six scientific workers of IIP were awarded Ph.D. degrees during 1990-91 in their fields of specialization. One scientist was awarded M. Tech degree from Roorkee University and was honoured with gold medal whereas two other scientists got M. Tech from IIT Delhi.

Other Events

Forty three research papers were published in various national and international journals, whereas 14 papers were presented in different seminars, symposia, workshops and conferences. Three patents were filed during the year. IIP also conducted 5 training courses to impart training to the technical personnel from petroleum and related industries. In all 65 personnel participated in these training programmes. During this period, 7 scientists of IIP were deputed abroad under various international scientific collaboration programmes, whereas 5 eminent scientists from abroad visited the institute. National Science Day, CSIR Foundation Day and IIP Foundation Day were celebrated during the year. On these occasions renowned scientists delivered talks. Other activities included essay and quiz competitions, demonstration of computer simulation and modelling. IIP has a healthy tradition of organising colloquia on scientific topics by visiting scientists from abroad and within the country and 10 talks were organised during the period.

AREA I

PETROLEUM REFINING TECHNOLOGY

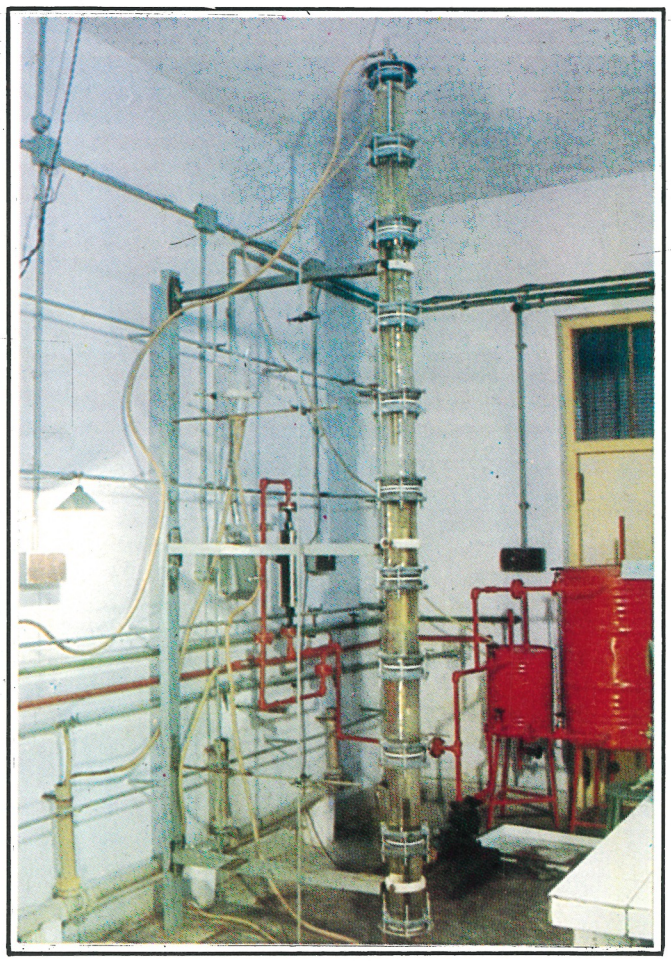
PETROLEUM REFINING TECHNOLOGY

SEPARATION PROCESSES

Aromatics Extraction

Production of Food Grade Hexane using Sulpholane as Solvent

IIP scientists and EIL engineers participated in the guarantee runs on hexane unit at BPCL, Bombay during August 1990. The food grade hexane produced (25,000 tpa) contained about 0.2 wt% of benzene. The unit is running smoothly.



4" Dia Glass Sieve Plate Column for Liquid Liquid Extraction Hydrodynamic Studies

Development of Technology for Production of Food Grade Hexane by Extraction with NMP

Basic liquid-liquid extraction (LLE) data were generated on raw hexane -NMP + 10% water systems at 40°C. The concentration of benzene was varied by adding the calculated amount of benzene in raw hexane.

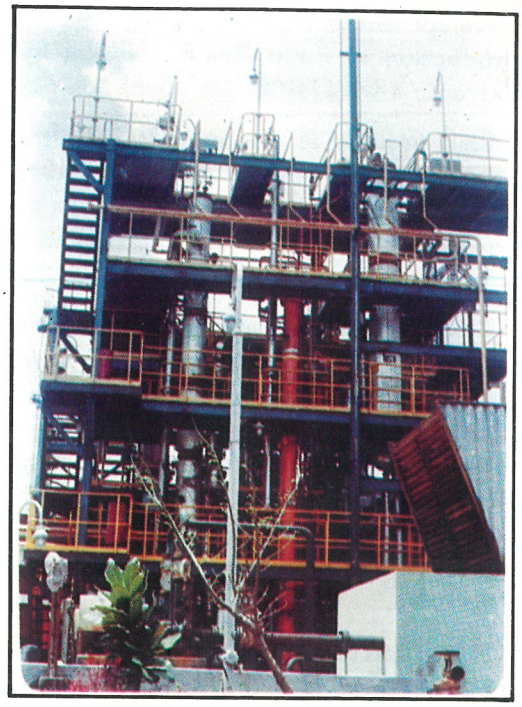
Continuous counter current extraction runs on packed column (Intalox saddles) were carried out at 40°C for raw hexane containing 4 and 15 wt % of benzene using NMP as solvent. The water content in NMP was 5, 10, 15 wt.%. In all six runs under varying operating conditions were carried out Computer simulation was carried out for these runs.

Bulk extract phase collected from the continuous runs in packed column was studied for solvent recovery on continuous Oldershaw column unit under different operating conditions like number of plates, stripper water and reboiler temperatures.

Scale-up data were collected on pilot plant at HPCL, Bombay. The feed used was Persian Gulf hexane cut (63-69°C) containing 3.9 wt.% benzene. The solvent used was NMP. Total seven runs were taken under different operating conditions like solvent to feed ratio, temperature and water content in the solvent. The benzene content of treated hexane was obtained in the range of 0.04 to 0.25 wt.% depending upon the operating conditions.

Dearomatisation of Kerosene for ATF

Scale-up data collection on pilot plant at HPCL, Bombay was continued. The system studied was Assam kerosene - Triethylene glycol. In all, three runs were carried out jointly by IIP, EIL and HPCL under different solvent-to-feed ratios. The samples collected were analysed at IIP.



Solvent Extraction Pilot Plant at HPCL Bombay (ATF & Food Grade Hexane Technology Development)

Demonstrations runs on ATF technology were given at HPCL, Bombay for Digboi refinery, with the participation of AOD, IOC, EIL, IIP and HPCL. The kerosene feed was procured from Digboi refinery. Various presentations were made for the commercialisation of this technology by EIL and IIP.

Simultaneous Dearomatisation of Naphtha and Kerosene

Continuing the studies, the results were correlated using UNIFAC solution model and the facets of compilations include :

— Basic LLE and mass transfer data on Bombay High and Assam naphthas and kerosenes with two solvents.

— Calculated equilibrium data by UNIFAC.

— Results on the effect of temperature gradient and/or anti solvent on extraction.

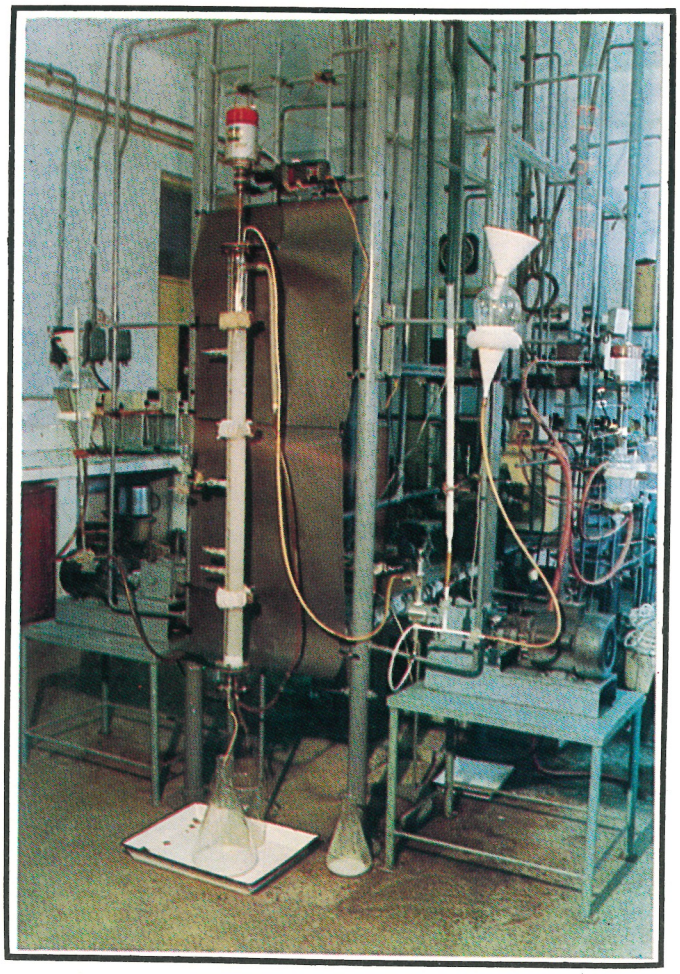
— Results on solvent recovery studies from extract phases of hexane cut and kerosene.

— Results of simultaneous dearomatisation of Bombay High and Assam naphtha and kerosene in packed column.

— Results on model quaternary systems to explain displacement in Simex. A Ph.D. thesis on this work was prepared and submitted.

Basic Studies on Hydrocarbon Solvent Systems

Isothermal vapour-liquid equilibrium (VLE) studies on binaries tetralin-triethyleneglycol, methylnaphthalene - triethyleneglycol and methylnaphthalene -n- methylpyrrolidone at 160°C were completed and the results were



2" Diameter Extraction Column being used for Studies on dearomatisation of Naphtha and Kerosene using Liquid Membranes on a continuous Scale'

correlated through different solution models and published.

Studies on water-toluene-NMP ternary system were taken up in the miscible region under isobaric condition at 760 mm/Hg. The data were tested for thermodynamic consistency and correlated through different model equations like NRTL, Wilson, UNIQUAC, UNIFAC and Redlich Kister. The data are useful in the design of solvent recovery column for NMP.

Studies on the synthesis of alkylated benzene, naphthalenes and the tetralins were continued. Butyl and hexyl tetralins were synthesised and heart cuts of mono alkyl tetralins were separated for further LLE studies.

Preparation of alkylated products of octane and tetralin is in progress.

LLE data on following systems were generated at 60 and 100°C.

Octyl naphthalene - cetane - sulpholane

Hexyl naphthalene - cetane - sulpholane

Butyl benzene - dodecane - TEG

LLE data generated have been predicted by UNIFAC, UNIQUAC and NRTL models.

The generation of basic LLE and VLE data using NMP, NFM and TEG were continued. The results were correlated by NRTL solution model and compiled. The data in all were generated and complied for the following systems:

— Basic LLE data for eight hydrocarbon solvent systems.

— Basic binary and ternary VLE data for ten hydrocarbon-solvent systems.

— Data on mutual solubility of hydrocarbons with solvents.

Based on the above work a Ph.D. thesis was prepared and submitted.

LLE/VLE pressure still was procured and commissioned. PVT cell of the still was calibrated for volume/height ratio and total volume. Preliminary experiments were conducted for toluene - CO_2 system.

Desulphurisation of Refinery Gases to Check Environmental Pollution

A detailed literature survey report was prepared and presentation made to engineers of Cochin Refineries Limited on the status of technologies on the subject. The literature report was submitted to the sponsor. An MoU has been worked out for collaboration work on the subject. Work is planned for development of candidate catalyst systems and evaluate them for desulphurising refinery gases.

Studies on Extraction of Benzene and Toluene with Tetra Ethyleneglycol

For extraction of aromatics, continuous extraction runs on packed column (Cannon Packings) were conducted at 45°C for Udex reformate - tetramethylene glycol + 5% water system, under varying conditions to generate mass transfer data.

Solvent recovery studies on Oldershaw column unit from extract phase obtained as above were carried out under vacuum. The effect of reboiler temperature was also studied and report submitted to the sponsor.

Studies on Liquid Membrane Permeation Processes

Studies on Liquid Membrane Permeation for Dearomatisation of Naphtha and Kerosene

A detailed report has been prepared which summarises the total information generated from experimental investigations carried out at IIP on dearomatisation of naphtha and kerosene by liquid membranes. Based on this

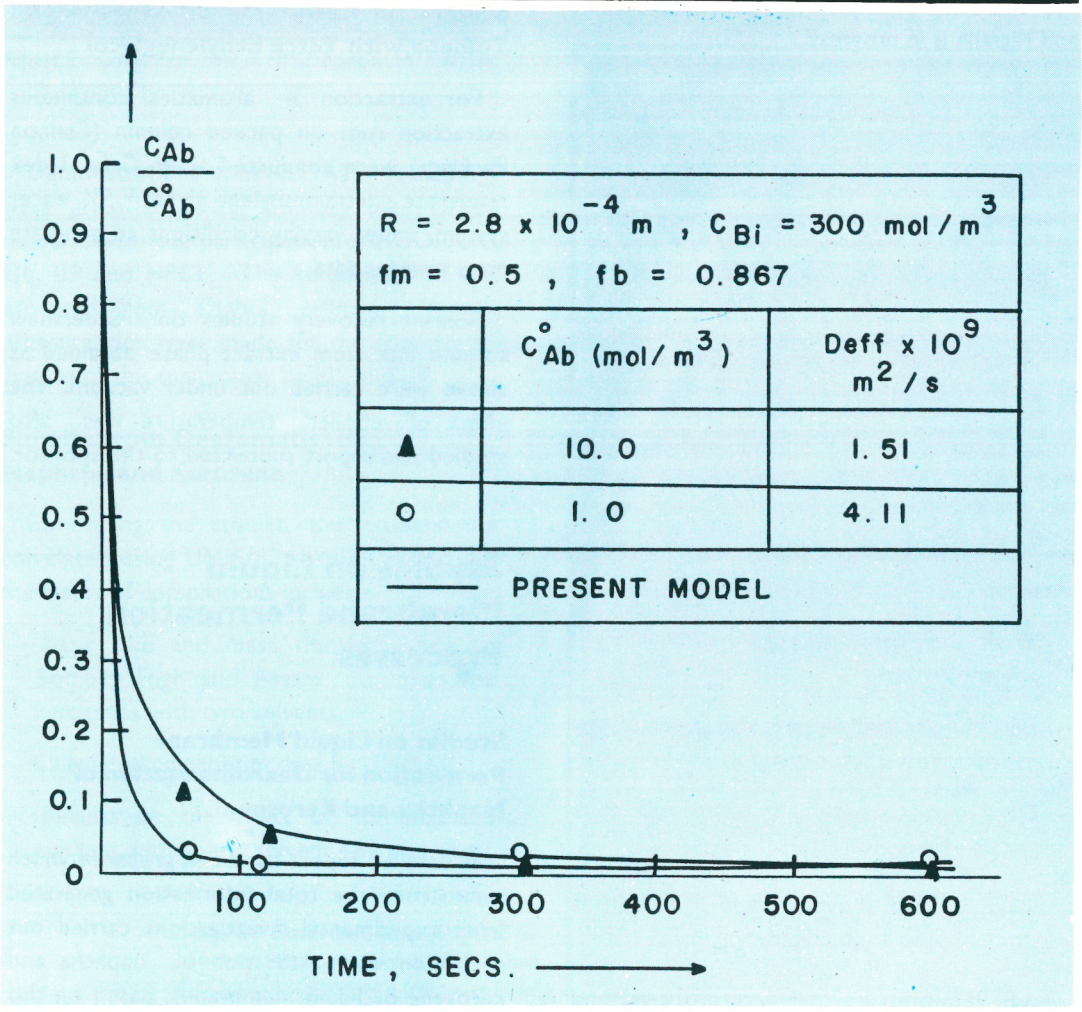
experimental data, models and correlations were developed, material balance and preliminary design estimates for a 500 t/d liquid membrane kerosene dearomatisation plant have been worked out and are included in the report. This report can form the basis for a techno-economic feasibility study of the liquid membrane dearomatisation process and has been circulated to EIL, CHT and HPCL.

Studies on Removal of Phenols from Effluent Water Through Liquid Membranes

Batch experiments on liquid membrane extraction of phenol from waste water were conducted under varying conditions of rpm, feed concentration, internal reagent concentration and time. The mathematical model of Bunge and Noble was modified by incorporating a shape factor, to simulate the experimental data and a sample of the model prediction is shown in the figure. A paper on this was communicated to Journal of Membrane Science.

A state-of-the-art report on liquid membrane separation was prepared and submitted to the sponsors.

SIMULATION OF LIQUID MEMBRANE PHENOL EXTRACTION EXPERIMENTS



Lubes and Bitumen

Solvent Extraction of Raw Lube Distillates and DAO Using NMP and Furfural as Solvents

To optimise the extraction temperature, the extraction runs at three temperatures i.e. 65/55, 75/65 and 85/75°C, keeping the same S/F ratio with interneutral distillate and NMP (with water) were carried out. From the data it was observed that the run at 75/65°C was giving better results. Extraction runs with furfural were carried out to assess the comparative performance with NMP. Preparation of narrow TBP cuts from interneutral raw lube distillate for LLE studies and their characterisation is in progress.

Solvent Extraction Studies on Prehydrotreated Raw Distillates to Make Quality Lube Base Stocks

Four feed stocks in two viscosity ranges were examined for their suitability to yield quality lube base stocks. One stock in each viscosity range was prehydrotreated. Detailed characterisation including Mass Spectroscopic analysis was carried out and HVI base oil potential using adsorption chromatography was determined. Prehydrotreated stocks showed an improvement of 6.5 to 8 wt.% for the desired VI range of base oils. Processing data with furfural showed that the prehydrotreated stocks gave higher raffinate yields and for the same VI the S/F ratio requirements are lower by 6.0% to 21.0% vol. Quality of the stocks was comparable. Technical report was compiled and submitted to the sponsors.

Development of Specialty Oils Using Adsorptive Separations

Two base oils were chosen on the basis of desired viscosity and specific gravity levels of technical grade white oils. These base oils were subjected to adsorption chromatography employing silica gel/alumina beds for saturate separation with a check through UV adsorption for aromatics. Samples are being prepared for further characterization.

Development of Process Sequence for the Production of Paving Bitumen from Non-Bitumenous Crudes and Studies on Modified Bitumen

A project proposal was prepared and sent to the relevant party. The project aimed at development of technological process sequence for the manufacture of paving bitumen from indigenous crudes through the route of short path distillation/solvent deasphalting. Project also envisages studies with bitumen modified with polymeric material to increase its life.

A literature survey report on modification of paving bitumen using polymeric material was completed and issued.

Dewaxing and Deoiling

Feasibility Study for Production of Paraffin Waxes from Different Feed Stocks

This feasibility cum process optimisation study undertaken at the instance of CHT, has been carried out to determine suitability of different available feed stocks for producing type 1, 2 and 3 paraffin waxes. MIBK was used as solvent. Simulated deoiling experiments were carried out under varying process conditions and suitable processing scheme was worked out for each stock on the basis of wax yield, quality, expected throughput and overall solvent/refrigeration requirements. A total of eight stocks were studied and besides generation of the basic data on quality of feed stocks, paraffin wax yield and quality etc. required for preliminary design and economic estimation, the results also indicate relative merit/potential of different feed stocks to facilitate identification of most suitable feed stocks. The final report was prepared and submitted to the sponsors

Feasibility Study on Production of Paraffin Wax from Barauni Wide Cut and Phenol Raffinate Stocks by Solvent Deoiling Using MEK-Toluene Mixture as Solvent

This investvation was taken-up at the instance of IOC to establish the feasibility and suitable processing conditions for production of type 2 paraffin wax from Barauni phenol raffinate and the 'wide cut' distillate. The solvent for the study was MEK-toluene mixture, which is already in use in the dewaxing unit at Barauni Refinery. The results indicate that both these stocks are suitable for type 2 paraffin wax production. However, relatively high oil content of the feeds necessitates a two stage processing to attain product oil content below 0.5%. In case of 'wide cut' distillate stock, a closer examination of overall economics is essential in view of low wax yield which is due to low wax content of the feed stock. Raffinate stock on the other hand is most appropriate feedstock for paraffin wax production. The study has been completed and the final report giving the results and recommendations was submitted to the sponsors.

Studies on Processing of PWD and HWD Stocks ex Digboi

Studies on solvent deoiling of pressable waxy distillate, PWD (370-480°C) and heavy waxy distillate, HWD stocks of Digboi Refinery were initiated as AOD intends to replace the existing technology of pressing and sweating by solvent deoiling technology. At present they are using PWD stock boiling in the range 325-480°C. The data on these stocks are required by EIL for preliminary design/costing of solvent deoiling unit and preparation of process package based on IIP-EIL solvent deoiling technology. The studies include process optimisation for dewaxing/deoiling steps using MEK-toluene (50:50) as solvent, generation of filtration/wash rate data and effect of variables on the process. For comparison MIBK/MEK (alone) will also be studied. Detailed characterisation of feed stocks and products will be done.

Deoiling experiments on PWD stocks have been carried out under varying conditions and a scheme has been selected for generation of required design data and preparation of bulk deoiled wax for detailed quality characterisation.

Process Conceptual Study for Production of Microcrystalline Wax (MCW) from Haldia Heavy Neutral (HN) and Bright Neutral (BN) Slack Waxes and White Oils

A process conceptual study was taken up for Birla Technical Services for production of MCW from Haldia HN and BN stocks. Detailed discussions were held to formulate the project with possibility of producing white oil by deep solvent dewaxing of foots oil. Preliminary experiments were carried out on BN slack wax.

Deasphalting

LLE Studies on Propane Short Residues

LLE data have been generated on propane short residue (ex HPCL) system at 50, 60 and 70°C with varying S/F ratios and feed compositions. Feed compositions were varied by blending DAO, obtained from batch equilibrium runs carried out separately with feed. The DAO/asphalt products were characterised. The data so generated were compiled and report issued.

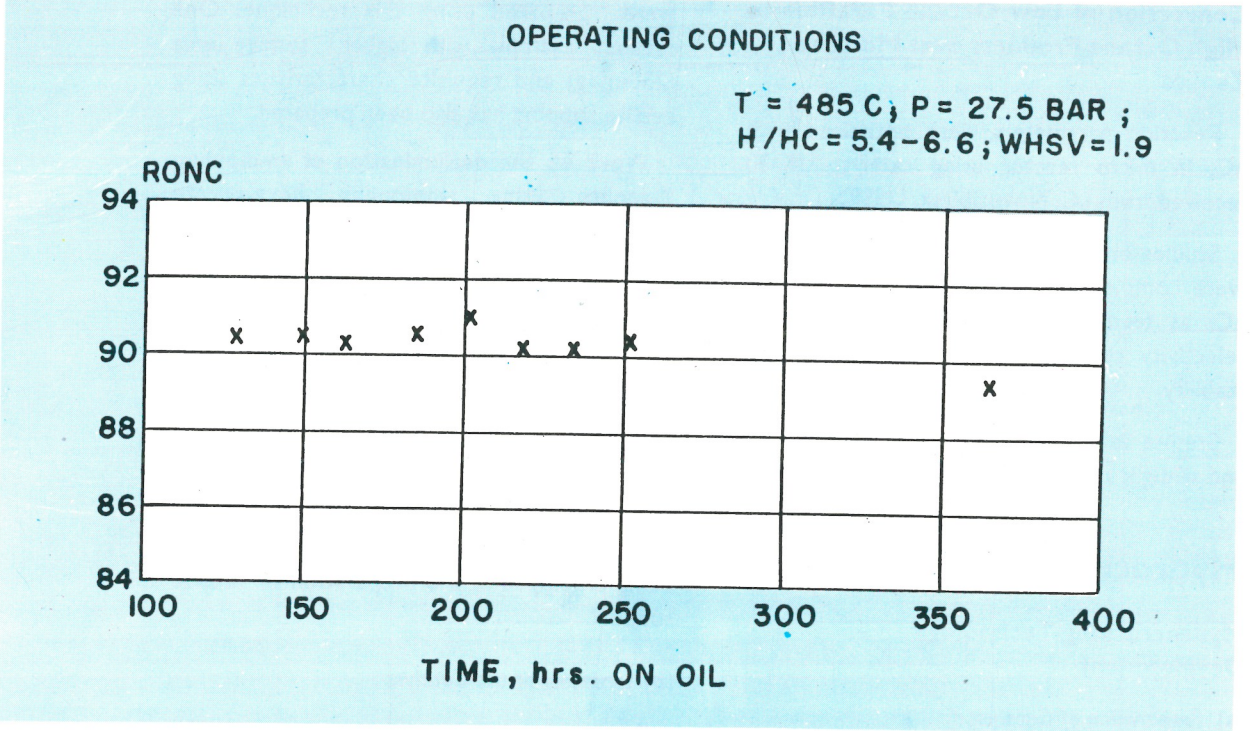
CONVERSION PROCESS

Catalytic Reforming Studies

Commercialisation of Bimetallic Reforming Catalyst

IIP-IPCL bimetallic reforming catalyst IPR-

RONC VS TIME (CYCLE I)
CAT.-IPR/2001 (550 Kg BATCH)



2001 was manufactured at CATAD unit of IPCL with IIP's participation. Commercial batches of this catalyst were thoroughly evaluated for its physico-chemical characterisation and performance in IIP pilot plant. The octane stability v/s time data on catalyst performance in pilot plant is presented in the figure.

For commercial trial of IPR-2001 catalyst's pre-start up checking, 6.2 tonnes of catalyst loading and commissioning activities were carried out at Catalytic Reforming Plant of MRL with the participation of IIP scientists/ engineers. The catalyst has been undergoing successful commercial trial at MRL for octane improvement since June 1990.

Monometallic catalyst at Gujarat Aromatics Plant (GAP), IPCL has also been replaced by 6.8 tonnes of IPR-2001 and the plant has been commissioned for production of xylene in January 1991. Yields at specified conditions for GAP reformer were estimated using reforming model developed by IIP. Catalytic reforming process model is being developed further.

Technical services were rendered on trouble-shooting, regeneration and restart-up of catalytic reforming unit at Haldia Refinery.

IIP's views on performance of CRL catalytic reformer for benzene production have been communicated to Cochin Refineries Limited by participation of IIP scientists/engineers at site and lab.

Development of Bimetallic Catalyst for Continuous Catalyst Regeneration (CCR) Operation

Three catalyst samples with different formulations on commercial alumina spheres were prepared. Attempts were made to make spheres-form commercial alumina powder. Efforts are continuing to meet their textural requirements. Experimental pilot plant studies

for evaluation of referenc commercial CCR are in progress.

Conversion of Low Octane Paraffins to High Octane Products over Modified Zeolite

Reaction parameters were optimised with nC_7 in micro reactor using catalyst UK-30 received from I.C. Novosibirsk, USSR.

Studies on catalyst deactivation with time were completed in micro reactor using pure nC_7 as feed. The results indicate high selectivity to aromatics but poor catalyst stability.

Studies in bench scale unit using pure nC_7 and straight run naphtha have been initiated.

Hydrocracking

Hydrocracking Technology Development

(a) *Preparation of Catalyst :*

The technique for the preparation of hydrocracking catalyst on titania promoted amorphous support was standardised. Physico-chemical characteristics are similar to a commercial reference catalyst. Two samples were prepared using this technique. One catalyst sample with higher surface area ($250m^2/g$) and requisite characteristics using zeolite support has also been prepared.

Work on the dealumination of ammonium Y-zeolite using ammonium hexa-silicate fluoride (chemical method) has been completed. Figure shows that with the decrease in dealumination the unit cell size decreases linearly with a consequent linear decrease in crystallinity. Crystallinity however remains above 85% even upto 60% dealumination.

The procedure for 30-90% dealumination of zeolite using hydrothermal treatment has been standardised. Dealuminated zeolites are being employed in the preparation of zeolitic support.

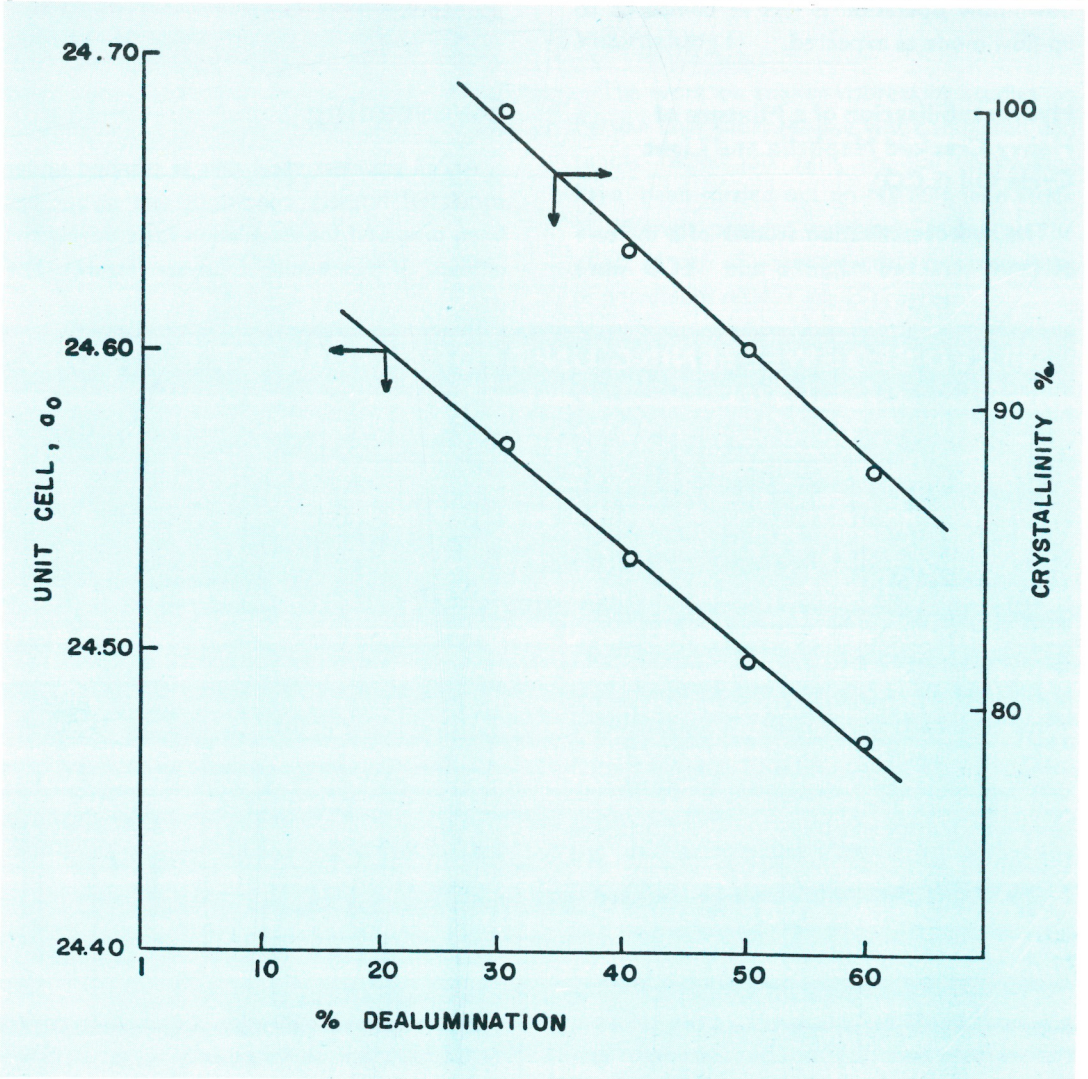
(b) *Screening of the Catalyst :*

An atempt is being made to use he technique of model hydrocarbon hydrocracking for screening of catalysts. Two hydro-

Deactivation of Catalyst (UK-30) with Time
Feed : Pure nC_7
Unit : High Pressue Microreactor

	Aromatics in the Product, wt%						
Time (hours)	Benzene	Toluene	Ethyl-Benzene	m, p-xylene	o-xylene	C_9^+	Total
1.0	2.8	13.1	3.3	15.1	13.0	5.5	52.8
2.0	2.5	12.6	2.8	12.3	10.7	5.1	45.4
4.0	1.5	9.4	2.6	10.3	9.5	4.8	38.1
8.0	1.1	7.7	2.0	8.8	7.7	4.7	32.0
12.0	0.9	6.9	1.9	8.5	7.7	4.4	30.3
16.0	0.8	6.1	1.7	7.4	6.7	3.5	26.2
20.0	0.6	4.0	1.3	5.3	5.1	3.1	19.4

DEGREE OF DEALUMINATION V/S UNIT CELL & CRYSTALLINITY



carbons namely n-heptane and toluene and a mixture of these two have been selected to study the acidic and hydrogenation activity of a reference catalyst (commercially proven) at different pressures and temperatures. Nearly all the cracked products have been identified. The data collected are being evaluated to develop a methodology for screening of hydrocracking catalysts prepared at IIP. Work on hydrocracking of model hydrocarbons using catalyst(s) prepared at IIP is in progress.

(c) *Evaluation of Catalyst :*

The manual bench scale unit has been modified for down-flow operation in order to avoid frequent coking problem in up-flow reactor in long duration experiments. After modification, continuous operation of the unit was carried out successfully for more than 200 hours with a reference catalyst on Bombay High vacuum gas oil. Subsequent experiments were carried out for more than

100 hours without any coking problem. The data obtained are being analysed but it is clear that once-through conversion of feed in down-flow operation is less as compared to up-flow mode as expected.

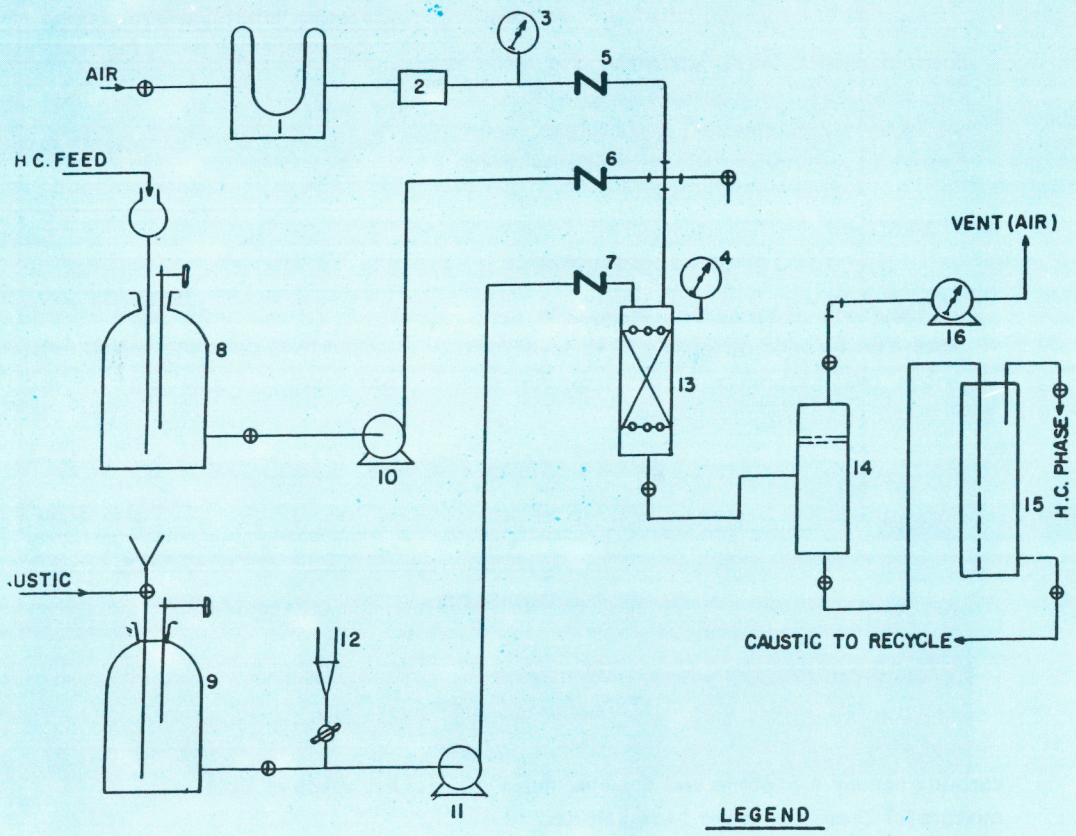
Hydrostabilisation of a Mixture of Heavy Cracked Naphtha and Light Cycle Oil (LCO)

The hydrostabilisation studies of a mixture of heavy cracked naphtha and LCO were carried out on a bench scale unit using two commercial catalysts. The work was completed and the report submitted to the sponsors.

Sweetening

An all stainless steel unit is planned under simulated refinery conditions and layout has been prepared for installation for studying the efficacy of sweetening catalysts (Figure). The

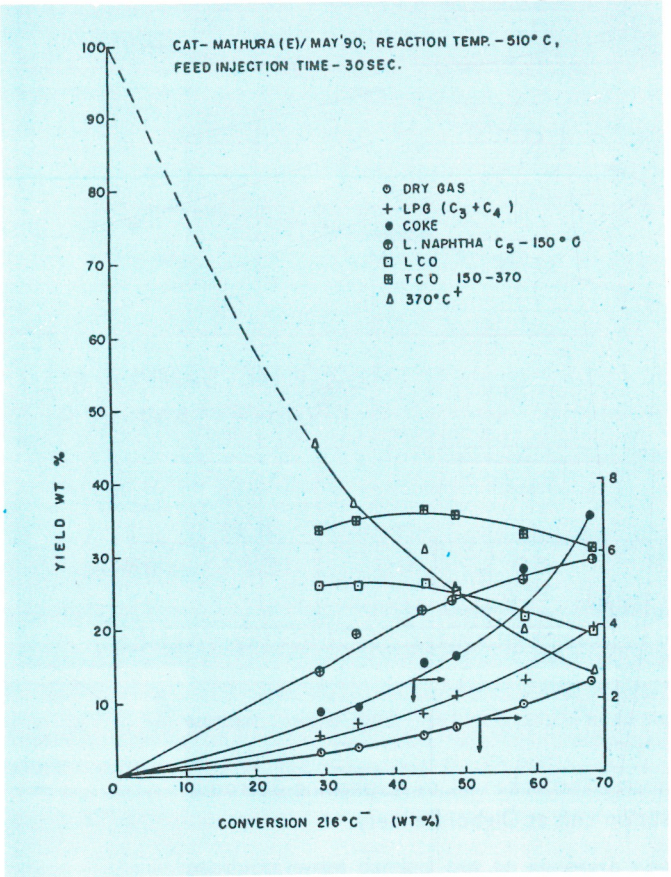
FIXED-BED SWEETENING UNIT FOR LABORATORY STUDIES



LEGEND

1	AIR TRAP	10,11	MICRO FEEDING PUMPS
2	CALCIUM CHLORIDE CONTAINER	12	CATALYST SOLUTION RESERVOIR
3,4	PRESSURE GAUGES	13	FIXED BED REACTOR
5,6,7	NON-RETURN VALVES (NRV)	14	GAS LIQUID SEPARATOR
8	FEED RESERVOIR	15	CAUSTIC SETTLER
9	CAUSTIC REAGENT RESERVOIR	16	GAS METER

MAT SIMULATION OF MATHURA FCC UNIT



fabrication of sweetening reactors and other vessels is being carried out. The materials with reference to equipment and chemicals are also being procured.

Exhaust Catalyst

Work is planned for development of wash-coat technique on commercially available monoliths and samples supplied by Central Glass and Ceramic Research Institute. The preparation of the catalyst will be taken up after development of technique for wash-coating the monoliths. Project proposal has been sent to Department of Science and Technology.

Thermal Conversion Processes

Visbreaking :

The work on soaker-visbreaking studies on Persian Gulf short residue was completed and report issued. Six runs on coil visbreaking have been carried out on Mathura feed stock at different process variables. Studies on the effect of rate of water injection on visbreaking of petroleum residue are in progress.

Fluid Catalytic Cracking (FCC)

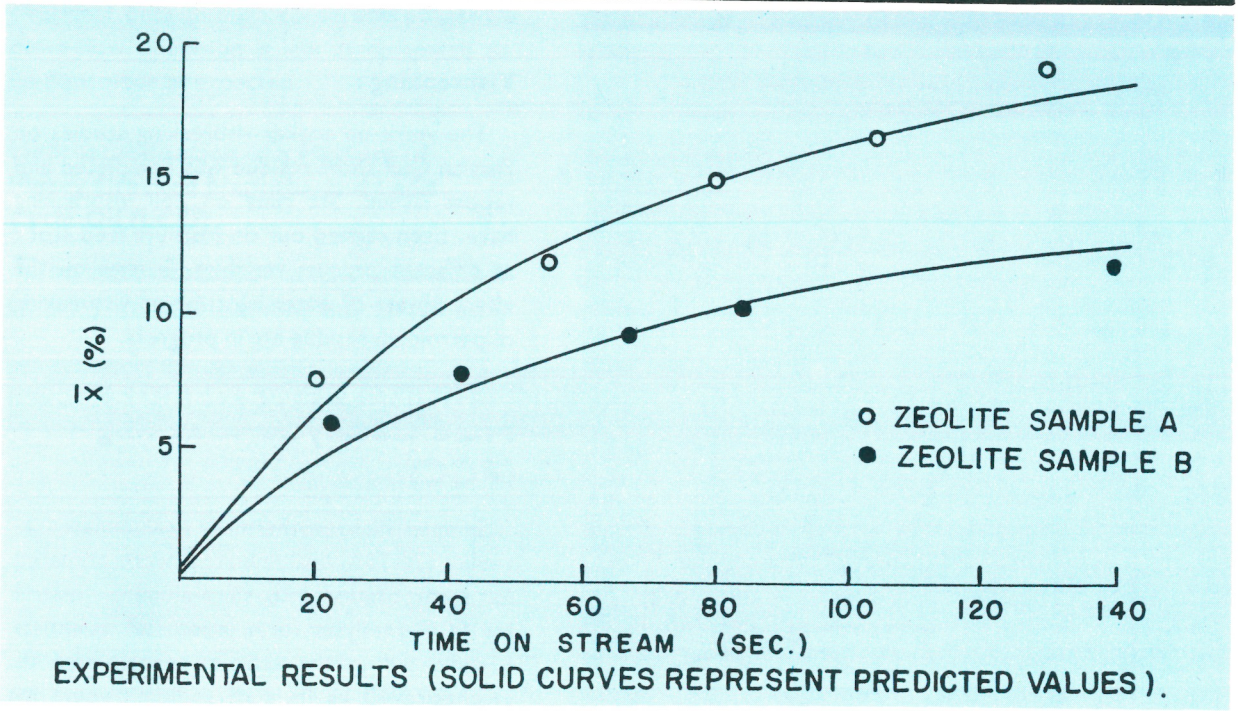
Samples of hydrothermally dealuminated Y-zeolite (30-75% dealuminated) were prepared for incorporation into silica-alumina matrix for FCC catalysts formulation. IIP scientists participated in the scale-up programme to synthesise 10 kg level of sodium zeolite by IOC R&D scientists at IIP. The samples of dealuminated Y-zeolite were characterised by XRD and the results are shown in figure. Simulation studies with Mathura feed for refinery yield optimisation were conducted. The results compared well with the actual refinery yields. Figure shows the product yield at different conversion levels.

Basic studies on cracking of C_{14}-C_{18} n-paraffins were carried out and overall cracking rate constant and catalyst deactivation rate constant were calculated for two differently dealuminated zeolite samples. The rate constants compared well with the degree of dealumination. Figure shows that experimental data fitted well with the theoretical curves.

Samples received from Hindustan Lever Limited and IOC R&D were characterized by XRD for crystallinity, micro calorimetry and ammonia adsorption techniques for acid sites measurements.

Optimisation studies on biocrude samples in xylene solution were carried out on Micro

AVERAGE CONVERSION (X) VS TIME-ON-STREAM:



EXPERIMENTAL RESULTS (SOLID CURVES REPRESENT PREDICTED VALUES).

Activiry Test (MAT) unit. Some commercial catalyst samples were characterized for MAT activity.

CRUDES AND PRODUCTS EVALUATION

Evaluation Studies

Short Evaluation of Crude Oils

Short evaluation comprising basic crude characteristics and key properties of broad cuts for North Gujarat, Dubai and Assam Mix Crudes were completed.

Evaluation and Chemical Composition of Kerosene Fractions from 85/15 Duliajan/Digboi-Kharsang HWC Blended Crude

Basic crude characteristics of 85/15 Duliajan/Digboi- Kharsang HWC blended crude, physico-chemical properties and chemical composition of light and heavy kerosene cuts (Figure) and their narrow fractions were studied for replacement of existing kerosene unit by sulpholane dearomatisation unit at Digboi Refinery.

Evaluation of BH Crude Naphtha Fractions for Xylene Production

Basic key properties of Bombay High crude were evaluated. Desired cuts were prepared and compositional studies were made to assess its potential for xylene production.

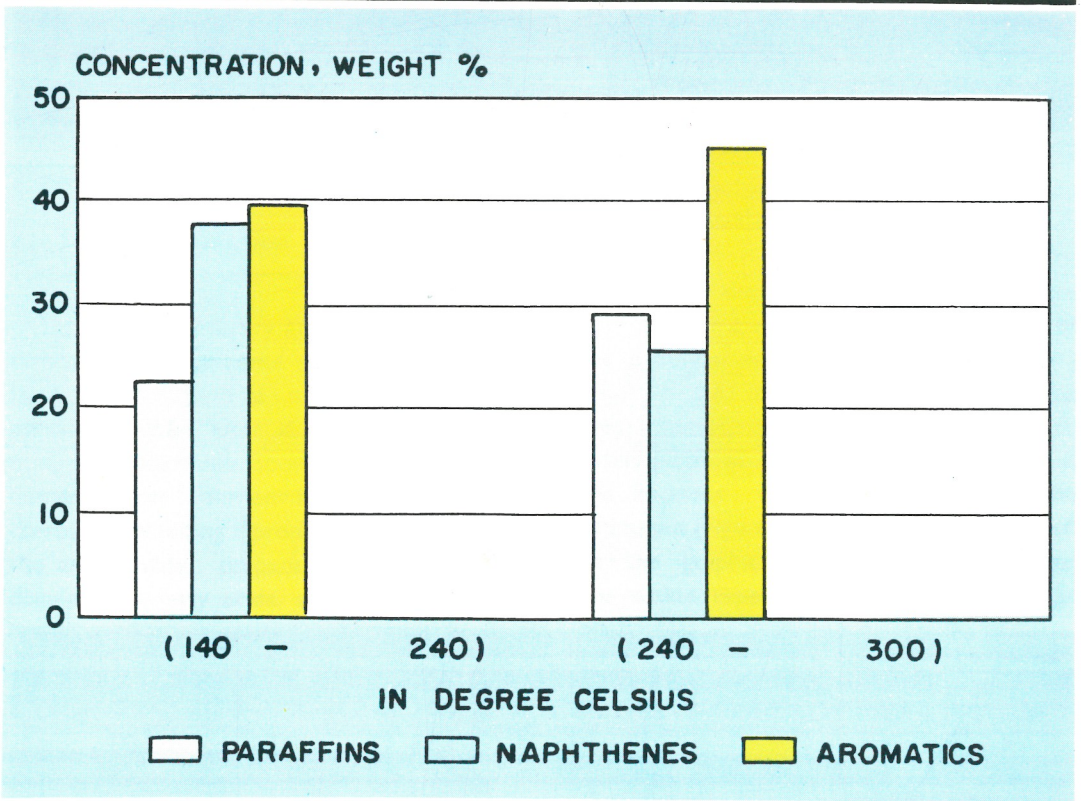
Evaluation of Crude Oils from Godavari Offshore (Ravva-10 and Ravva-17)

Key characteristics of crudes and their narrow fractions for product potential and quality were evaluated.

Structural Studies on Components of Selected Fractions from Crudes Being Processed in India

Investigations on petroleum fractions including kerosenes, waxes, heavy alkylate bottoms, vacuum distillates and hydrocracked

P.N.A. DISTRIBUTION IN LIGHT & HEAVY KEROSENE (COMPOSITE)



products were carried out to generate compositional data and isolate compound type concentrates for : analysis by instrumental techniques, use as model compound concentrates in HPLC and studies pertaining to kinetics of cracking of hydrocarbons.

Analytical data on feed stocks for hydrocracking and hydrocrackates are shown in the Table. Retention indices for a few test compounds, heavy alkylate bottoms and their chromatographic fractions and hydrocarbon type concentrates from kerosene and vacuum distillates are shown in the Table.

Characterization of Heavy Alkylate Bottoms and Development of Specification for Oil Soluble Sulphonate Feed Stock

Four reference heavy alkylate bottoms (HAB) and four indigenous commercial HABs were fully characterised for physico-chemical properties and compositional information using GLC, HPLC, UV, IR, ^{1}H and ^{13}C nmr and Z number distribution of high resolution mass spectrometry. The sulphonation behaviour of these light HABs, yield of oil soluble sulphonic acid, ease of preparation of high total base number calcium sulphonates from them were studied and quantified. Attempts were made to correlate the sulphonation behaviour with composition of these HABs. In order to identify desirable components in HABs from the view point of sulphonation, three HAB samples were sulphonated and the unsulphonated fraction was isolated for detailed characterization. It turned out that polar components presumably hydroxy-sulphonic acids, alkenyl sulphonic acids, sultones and sulphones were also formed. However, the bulk of unsulphonated HAB was identical to starting material,

Analytical Data on Feedstocks for Hydrocracking and Hydrocrackates

Sample	% Wt		
	Polars	Saturates	Aromatics
Feedstock 1	5.7	68.8	25.5
Feedstock 2	2.1	72.1	25.8
Feedstock 3	2.1	71.4	26.5
Hydrocrackates			
Distillate (270-370°C)	0.8	76.9	22.3
Residue (> 370°C)	0.9	95.2	3.9

Retention Data

Sample		t_x	K^1	Log I
Benzene		6.55	0.56	1.00
n-octylbenzene		5.83	0.50	0.88
Dodecylbenzene		5.44	0.46	0.82
Dodecylnaphthalene	(i)	9.48	0.81	1.33
	(ii)	11.58	0.99	1.45
Alkylbenzenes and naphthenologs	(i)	2.86	0.24	0.18
	(ii)	3.88	0.33	0.48
	(iii)	4.67	0.40	0.66
Naphthalene		17.94	1.53	2.00
Alkylnaphthalenes	(i)	10.36	0.88	1.42
	(ii)	12.17	1.06	1.59
Alkylnaptheno naphthalenes /biphenyls	(i)	20.48	1.74	2.14
	(ii)	20.87	1.78	2.16
	(iii)	21.58	1.83	2.20
	(iv)	22.30	1.90	2.30
Phenanthrene		46.22	3.93	3.00

t_x = Adjusted retention time (Min) K^1 = Capacity factor I = Retention index

suggesting that sulphonation was not selective. Two samples were subjected to vigorous sulphonation. Their unsulphonated portion showed presence of carbonyl compounds resulting from oxidation by SO_3. Based on the above a tentative specification for acceptable HABs has been shown in the Table.

Corrosion Studies

Studies on Corrosion of Hydrocarbon Handling and Processing Systems

Three known primary amines of C_{12} to C_{18} carbon atoms and some additives prepared from saponification of non-edible oils and ethylene diamine were used for evaluation using in Dubai crude. Some of the fatty acids derived from non-edible oils exhibited corrosion inhibiting properties. In addition, the aminoamide, prepared from ethylene diamine and fatty acids, showed corrosion inhibiting effect.

TRANSPORTATION AND HANDLING OF CRUDES AND PRODUCTS

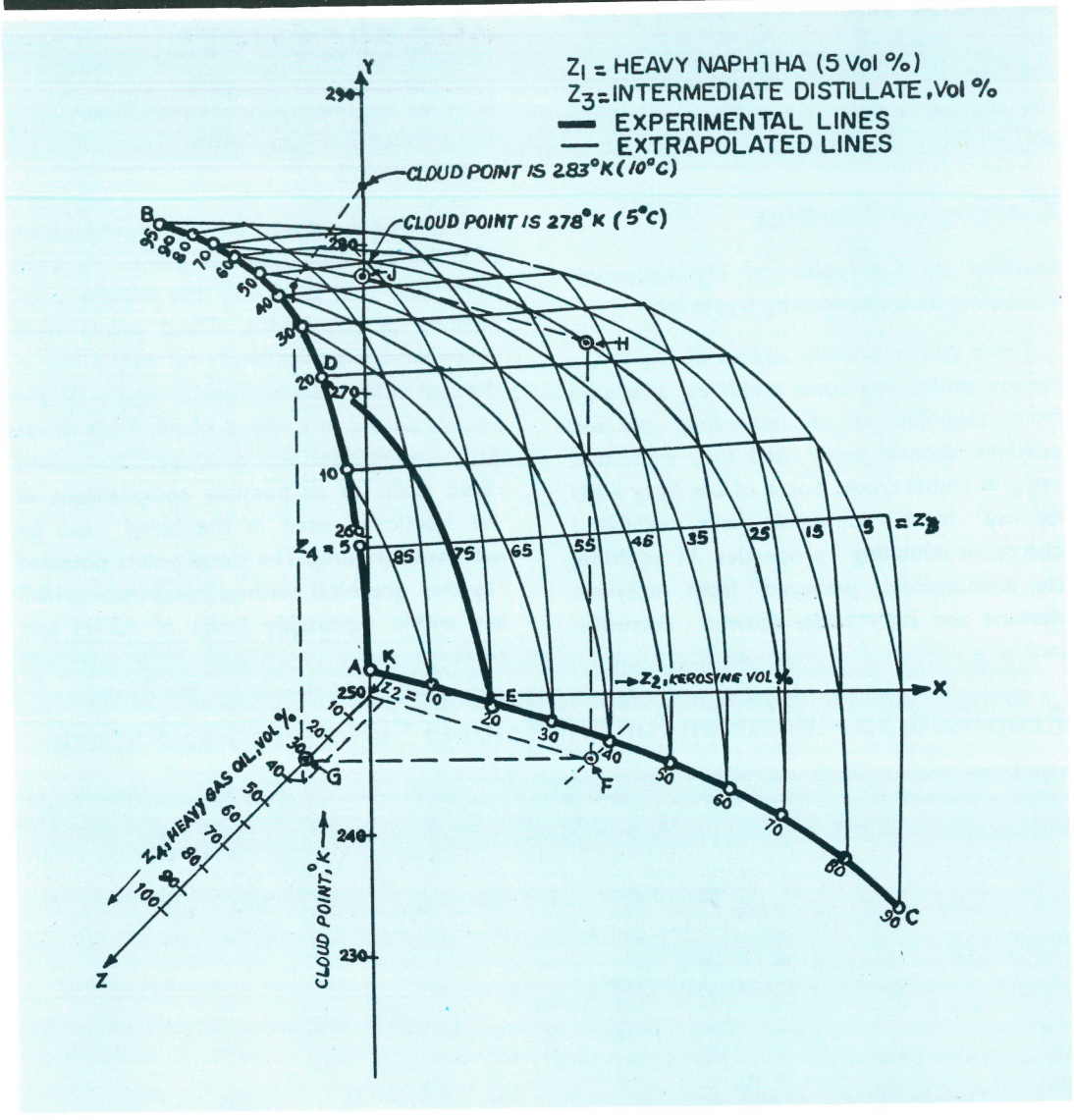
Studies on Low Temperature Flow Behaviour of Waxy Crudes and Products

A graphical method for the determination of cloud point of diesel oil blends has been developed that uses only the volume composition of the blends. Cloud points were determined experi-mentally for only a few of the potential volume percentages of the fractions used in a diesel blend. From these data, a nomograph was developed from which cloud point of all possible compositions of the fractions used in the blend can be estimated (Figure). The cloud points obtained by the graphical method compare well and are within repeatable limits of ASTM test method.

Proposed Specification for Oil Soluble Sulfonate Feed Stock

	TEST	LIMITS
1.	Distribution (ASTM D-86) Initial boiling point, °C% distilled at 375°C.	To be reported 5 max (vol/vol)
2.	Carbon Number Distribution by G.C. (IIP procedure).	
	Below C_{22}	5% max
	Above C_{40}	5% max
3.	Density IP-365, 15.6°C	To be reported
4.	Aniline point, IP—130	- do -
5.	Molecular weight by VPO, ASTM-D-2503	350 min.
6.	Kinematic viscosity ASTM D-2422	
	cSt at 40°C	30 min. 50 max.
	100°C	To be reported
7.	Bromine number ASTM D-1159	4.0 max.
8.	% Unsaturation (IIP method)	
	Alkyl benzenes + Alkyl naphthalenes	95% min.
	Trinuclear and higher aromatics.	1.5 max.

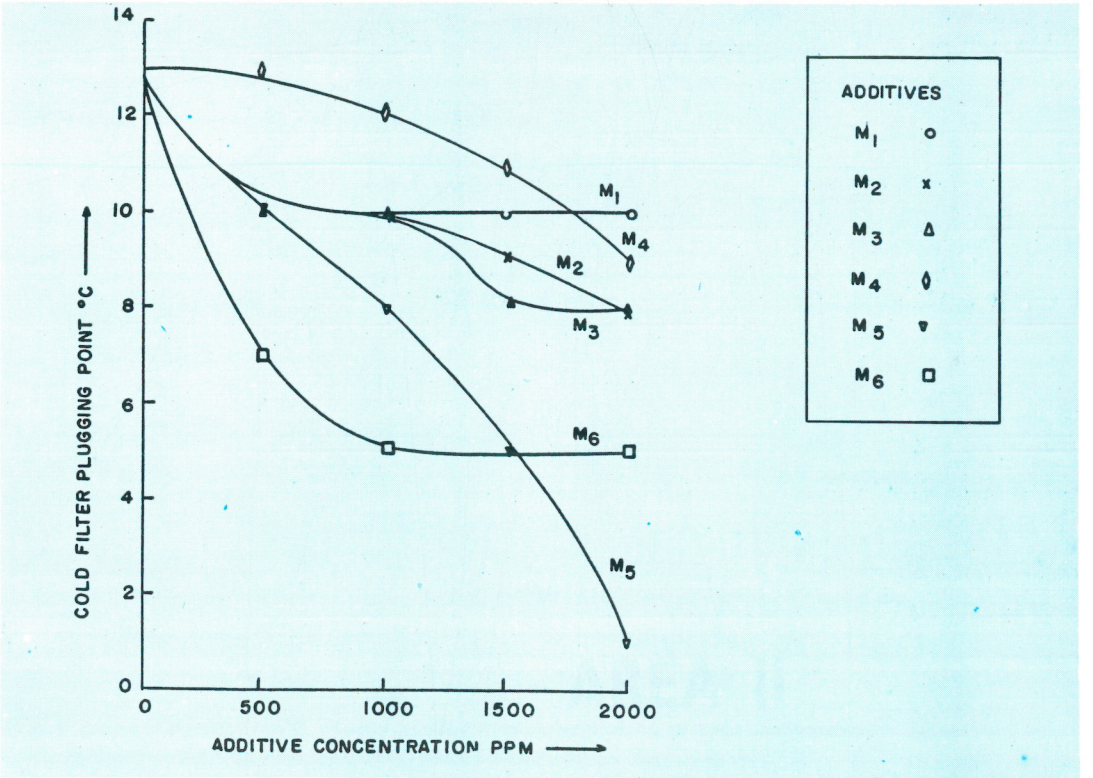
CLOUD POINT OF FOUR-COMPONENT DIESEL BLENDS



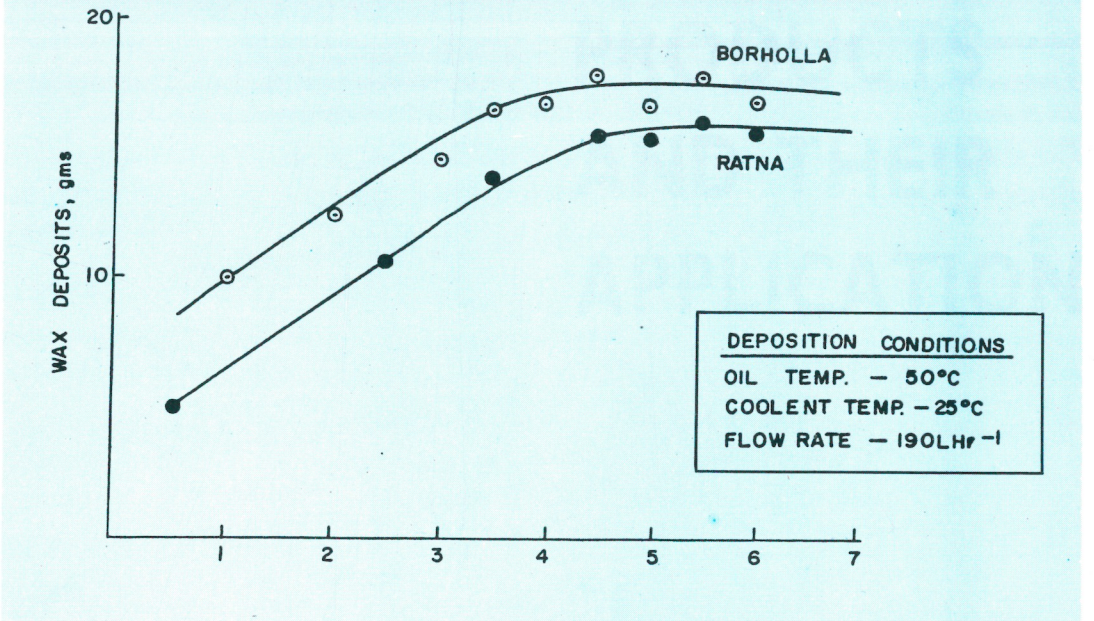
Response of six commercial flow improvers on the cold flow properties and wax dispersing performance of commercially available high speed diesel fuels in relation to fuels composition has been determined (Figure).

Wax deposition behaviour of Ratna and Borholla crudes have been studied under flowing conditions. Effect of time, oil temperature, cold surface temperature and flow rate on wax deposition have been deterined (Figure).

EFFECT OF ADDITIVES ON COLD FILTER PLUGGING POINT OF COMMERCIAL DIESEL OIL



EFFECT OF TIME ON WAX DEPOSITION ON RATNA AND BORHOLA CRUDE OIL



AREA II

PETROLEUM PRODUCTS AND THEIR APPLICATIONS

PETROLEUM PRODUCTS AND THEIR APPLICATIONS

ENGINE FUELS AND LUBRICANTS

Engine Fuel Efficiency and Combustion Studies

Development of Two-Stroke Engine Powered Vehicle with Improved Fuel Economy and Low Emissions

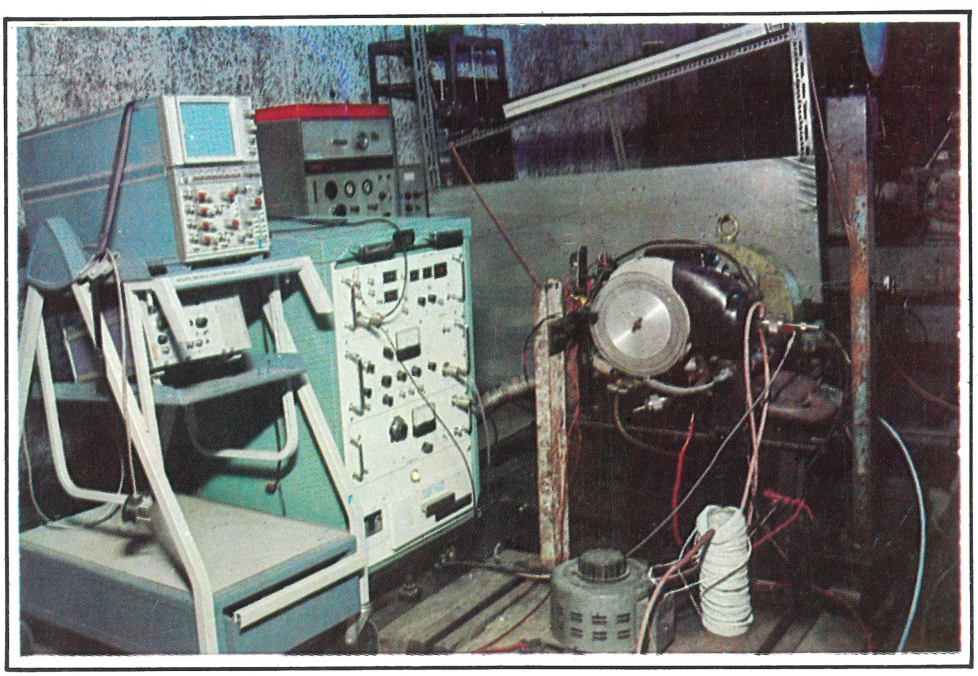
A new concept dual intake engine using selective exhaust gas recirculation (SEGR) was studied on engine test bed. The concept is based on recirculating selectively the hydrocarbon rich portion of the exhaust gas. These gases are fed to the transfer passages and are not allowed to mix with fresh charge, which is filled in the crank case. The exhaust gases thus enter the cylinder first. Upto 14% improvement in fuel economy and 35% reduction in hydrocarbon emission was observed in test benches.

Scavenging Studies in Two-Stroke Engine

A series of port designs by modifying the existing cylinder of a two-stroke engine were fabricated and their effect on part throttle fuel economy was studied. The upward and side angles were varied and their effect on fuel consumption and cyclic variations in peak pressures was studied. The studies helped in understanding the role of port geometry on cyclic variation and part throttle fuel economy. Improvements in fuel economy were small with these modifications.

Irregular and Abnormal Combustion in 2-Stroke SI Engines- their Control and Improvements in Fuel Efficiency and Emissions through Scavenging Reorganisation

Some of the causes for irregular combustion and misfiring in a two-stroke engine were identified. The regime and location of misfiring is dependent on delivery ratio. It

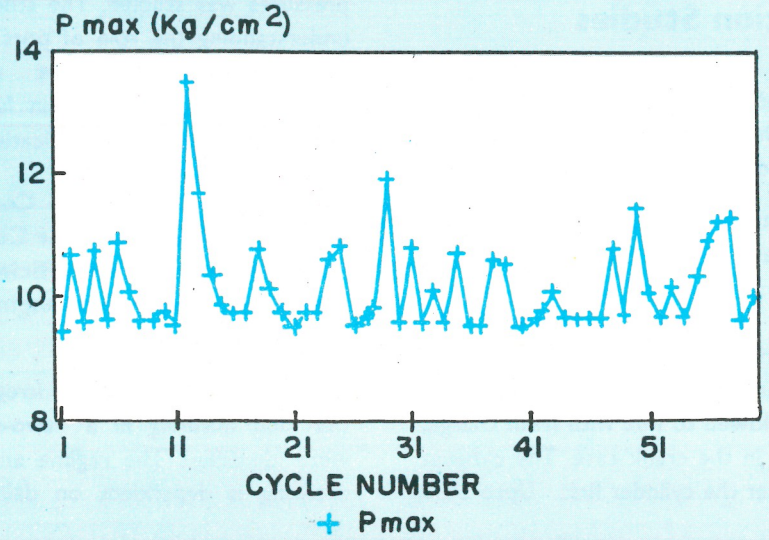


Set up for in Cylinder Gas Sampling in I.C. Engines

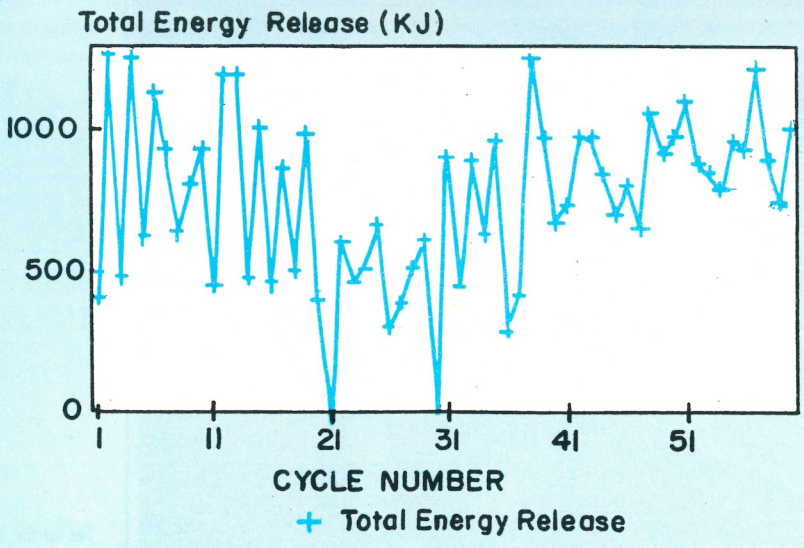
was seen that below delivery ratio of 0.3 irregular combustion starts. A plot of the variation in peak cylinder pressure and heat release for individual cycles in misfiring regime is shown in Figures. An estimate of misfired and partially burned cycles is shown in the Table. The study could identify that the phenomenon of misfiring is affected by poor local scavenging near spark plug region which could be improved by port geometry modification. Effect of port geometry on irregular combustion was studied. This study could further substantiate earlier findings.

Average loss of fresh charge in an engine has been evaluated at different operating conditions. For the investigation of the history of losses with respect to crank angle,

PEAK PRESSURE OF CONSECUTIVE CYCLE AT MISFIRING REGIME



TOTAL ENERGY RELEASE OF CONSECUTIVE CYCLE AT MISFIRING REGIME

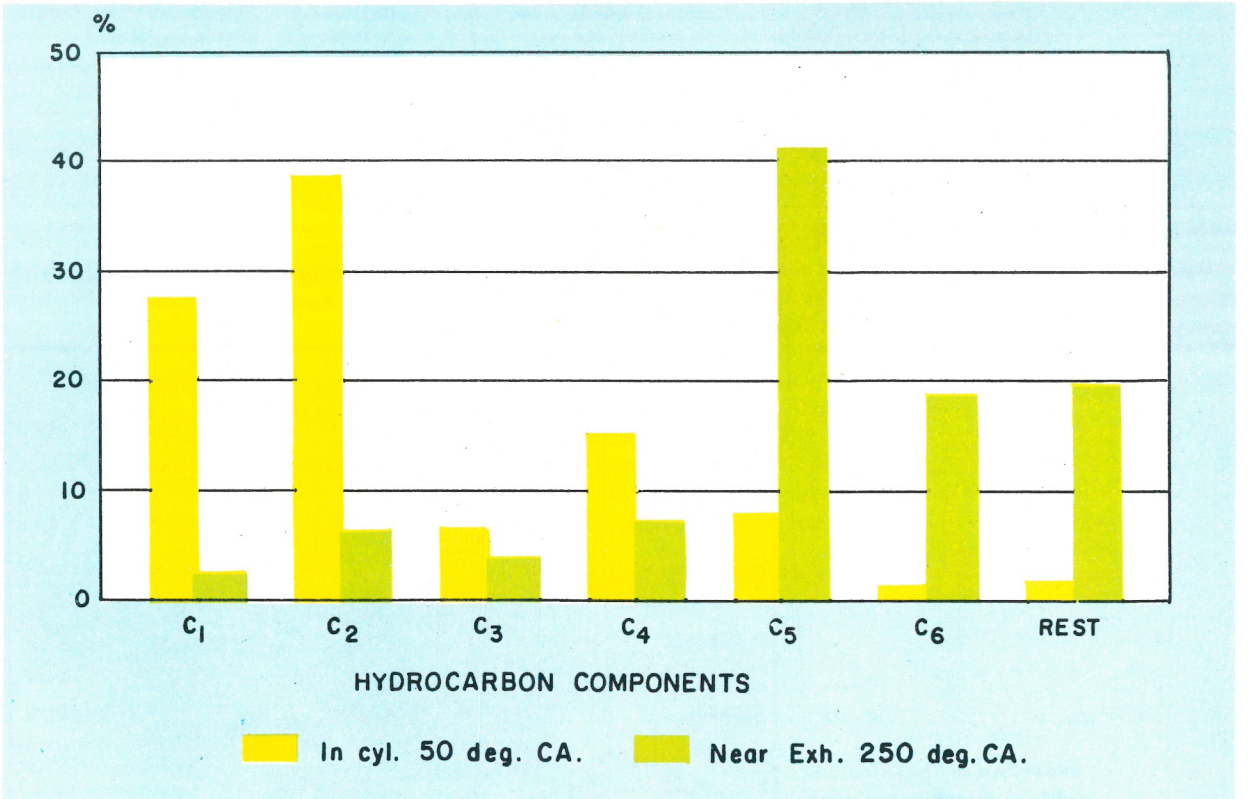


Estimate of Partially Burned and Misfired Cycles, 3000 rpm, sp 22 deg Btdc

Delivery Ratio	Partially Burned Cycles (%)	Misfired Cycles (%)	Normal Cycles (%)
0.66 - 0.3	Nil	Nil	Nil
0.24	12.2	Nil	87.8
0.21	18.9	8.9	72.2

a high speed sampling technique was used. The investigations into the history of hydrocarbons in the exhaust showed that the hydrocarbon composition of the cylinder gases during expansion period and in the exhaust was quite different. Hydrocarbon (HC) composition at the exhaust port showed large amount of HC with higher carbon number. A comparison of carbon number of gases inside the cylinder during expansion with the carbon number near exhaust port is shown in Figure.

COMPARISON OF COMPONENTS OF HYDROCARBONS IN A TWO STROKE ENGINE



Engine Related Studies

Fuel Injection Characteristics of LCV Engine Fuel Pumps

Two different fuel injection pumps for a light commercial vehicle (LCV) engine were studied for injection characteristics. The parameters studied were injection rate, injection duration and droplet size distribution. A specially fabricated TSNITA chamber was used for measurement of instantaneous injection rates. Droplet size distribution was studied using Malvern Particle Size Analyzer which employs laser diffraction technique.

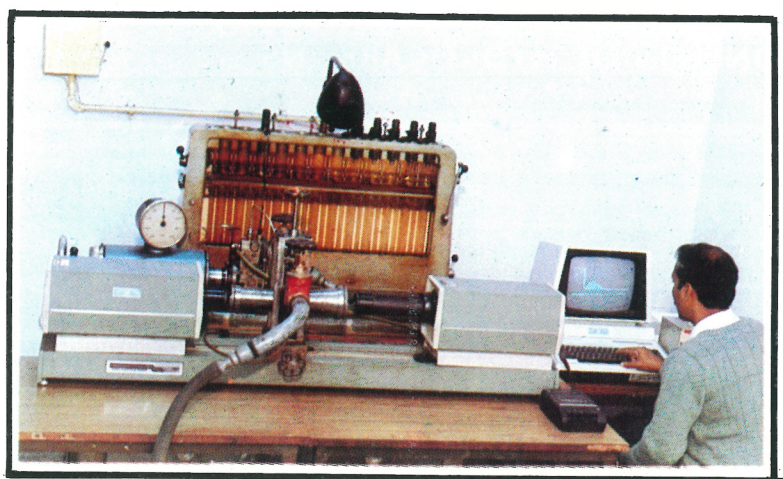
Combustion Pressue Studied on Motor Cycle Engines

Six engines of two and four stroke cycle used for motor cycle applications were investigated for combustion, intake and exhaust pressures. The pressure-time histories were compared and relative performances of the engine were studied. Recommendations for combustion improvements were given to the sponsors based on the relative performances.

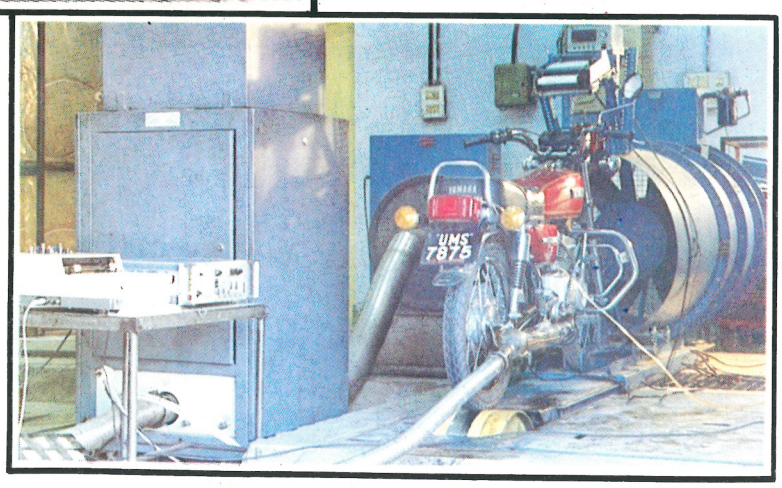
Fuel Quality Studies

Octane Requirements of Two-Wheelers

The octane requirement of one make of two-wheeler was estimated. On the test bed, range of critical speed and load for knock was determined. In this critical operating range, octane requirement was determined on the test bed. On chassis dynamometer, the octane requirements of three vehicles of the same make, having a mileage build up of 8,000 to 10,000 kms were determined.



Set-up for Droplet size distribution studies of Fuel Injection Pumps of Diesel Engine



Motor Cycle on Chassis Dynamometer for octane requirement studies

Effect of Diesel Fuel Quality on Engine Performance and Operation

A literature review report on the phenomenon of injector nozzle coking in diesel engines and fuel quality effect was prepared. An air flow rig as per ISO was fabricated to determine the flow characteristics of injector nozzles. Used injectors taken from IIP bus and UPSRTC buses were evaluated for coking, to assess the severity of the problem in direct injection diesel engines. The degree of coking is shown in Figure.

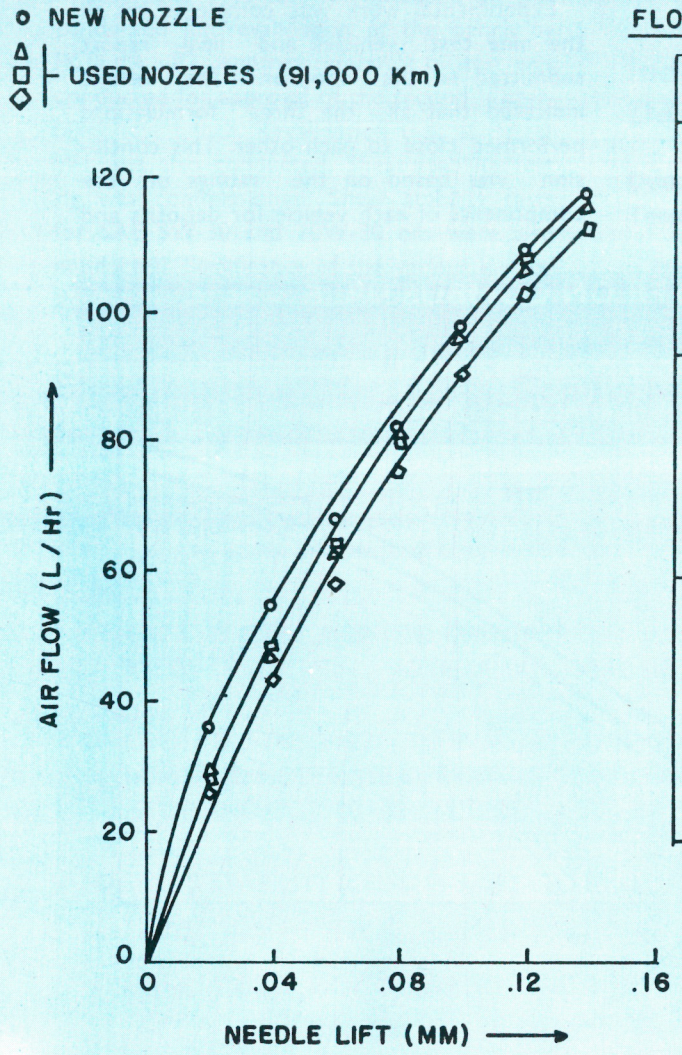
Oxidation and Storage Stability of Gasoline : Effect on Engine Performance

A literature survey report was prepared.

— Work was started on development of a carburettor cleanliness test on Maruti. engine. A number of tests were conducted with modifications in test conditions. More tests are needed for establishing the repeatability within of the method.

— One test each with reformate and blend

DEGREE OF COKING IN FUEL INJECTORS OF D.I. DIESEL ENGINE



FLOW REDUCTION VALUES

INJ.	NEEDLE LIFT (MM)	% AGE FLOW REDUCTION
Δ	.02	19.30
	.04	13.92
	.06	7.69
	.08	.24
	.10	1.56
	.12	2.19
	.14	1.27
◇	.02	27.23
	.04	20.36
	.06	14.20
	.08	7.91
	.10	6.70
	.12	6.23
	.14	4.25
□	.02	20.83
	.04	11.98
	.06	6.65
	.08	1.58
	.10	1.54
	.12	1.46
	.14	.14

of reformate with FCC (50:50) were conducted using CLR-LTD technique to study the effect of fuel composition and stability on engine oil performance.

BIS/IIP CFR Correlation Scheme

One sample of gasoline was sent to participating laboratories and the results were analysed statistically and report finalised. The data show that the results from most of the participating laboratories are the ASTM limits.

Computer Simulation of Engine Processes Development of Mathematical Simulation Model for Diesel Engine

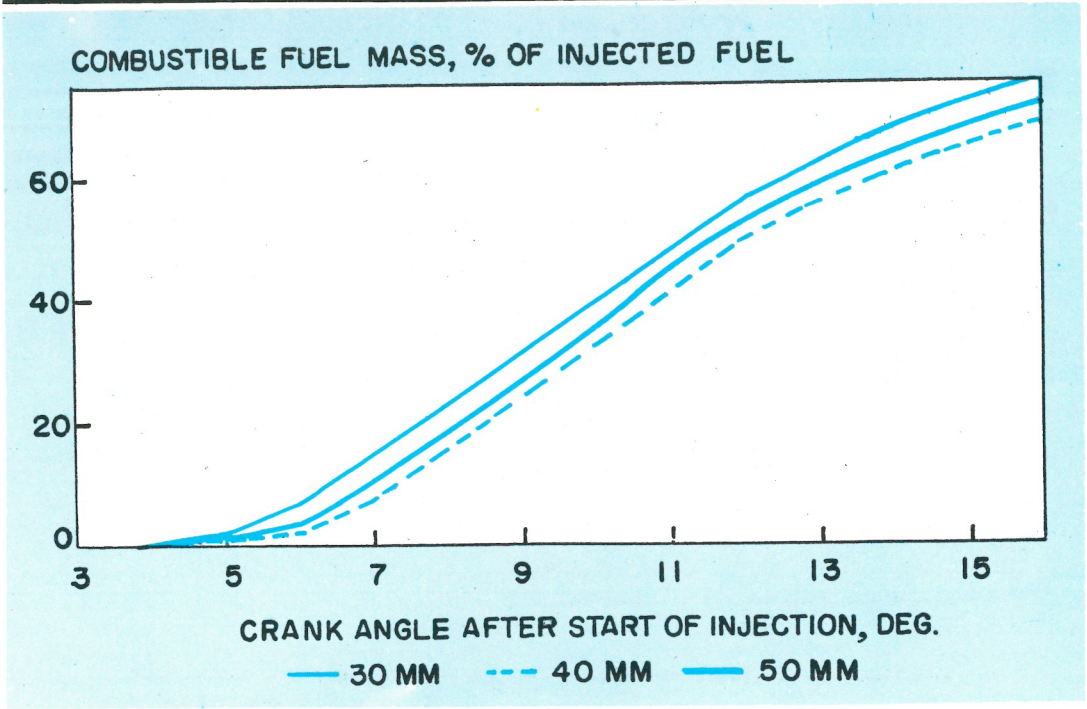
A mathematical model for simulation of diesel engine is developed including spray-swirl interaction and wall jet effects in the combustion chamber. The model compares well with the experimental data on spray motion and mixing taken from published work. Fuel burning rates and performance parameters of the engine are also computed. Figure shows the influence of pistion bowl diameter on combustible fuel-air mixture available at the given instant.

Performance Evaluation Studies

Comparative Studies on 2T Oil Formulations through Field Evaluations

Experimental work was completed on all the nine test vehicles and final report submitted to the sponsor. The results indicated that all the three formulations performed close to each other. This conclusion was based on the ratings of the components of each vehicle for deposits and

EFFECT OF BOWL DIAMETER ON COMBUSTIBLE VAPOUR MASS



wear. Bench test studies conducted on each engine for evaluating piston anti-seizure performance also indicated their close performance behaviour and all were at the same level as the high performance reference oil.

Performance Evaluation of Crankcase Oils for Certification

Caterpillar 1H2 tests were conducted on four candidate oils, and reports were submitted to the sponsors. CLR-LTD tests were conducted on six oils of monograde and multigrade type. Four oil qualification certificates were issued.

Caterpillar 1H2 test on reference oil was conducted for revalidation of the bench by PCD : 4 : P2. Another reference oil test was conducted for approval of the second Caterpillar test bench. Revalidation test of Petter W1 was also conducted. Shear stability test rig was commissioned. Shear stability tests for SAE 5W-30 and 10W-30 oils were also conducted. Significance of the various evaluation tests is shown in the Table.

Performance Evaluation of 2T Engine Oils

Deposit and general performance tests were conducted on two samples of 2T engine oils. Test for preignition tendency was also carried out on one oil sample.

Evaluation of Fuel-Economy Additives and Devices

RM-2000 additive was evaluated on Bajaj Super Engine. Diesel fuel additives RM-2000, MOBILAD F-801 and NBR-ST-308 were evaluated on Tata engine. These additives were evaluated to study fuel economy improvements. The reports were submitted to PCRA.

Indigenous Test Technique Development

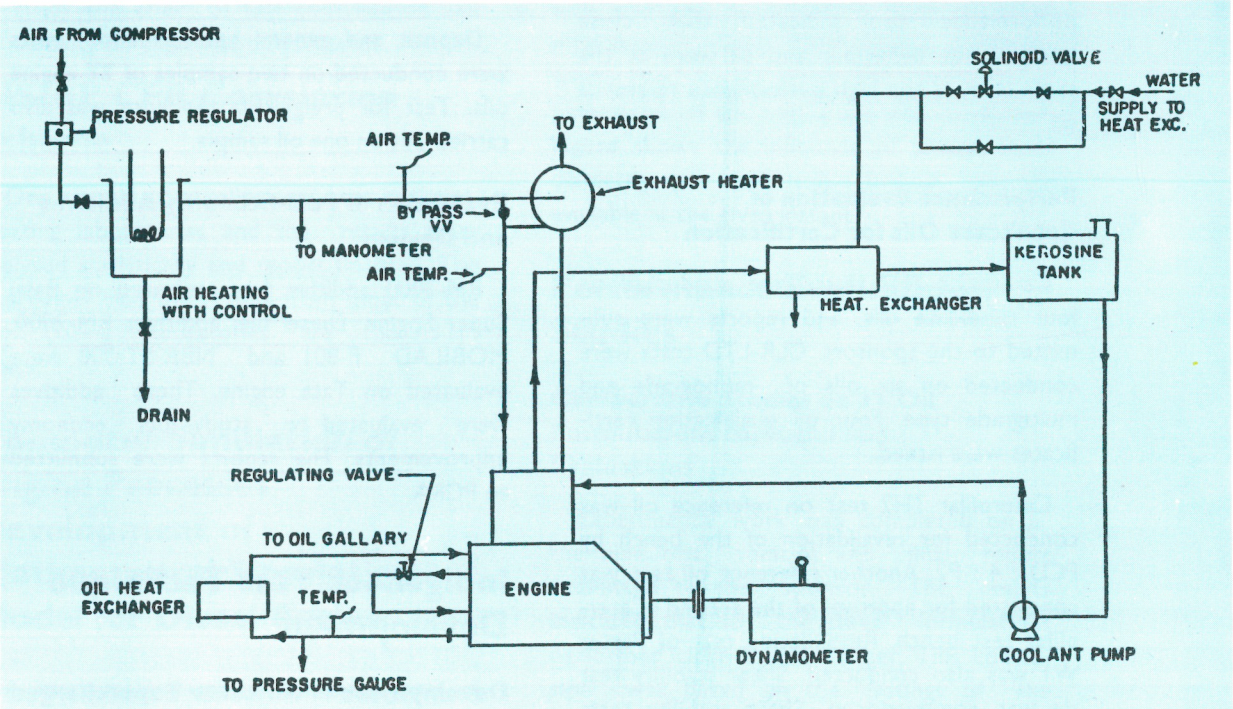
Development of Kirloskar Supercharged Test Technique

New experimental engine developed and fabricated by Kirloskar Oil Engines Ltd was

Significance of the Tests Conducted to Qualify Engine Oils for HD Type-3 and API SF/CC Quality Multi Grade Oils

1. : CATERPILLAR 1H2 (FTMS : 346) - TO EVALUATE ENGINE CLEANLINESS PROPERTY: 480 HOURS TEST
2. CRC L-38 (FTMS 3405) - TO EVALUATE CHARACTERISTICS OF ENGINE OIL TO RESIST OXIDATION AND BEARING CORROSION : 40 HOURS TEST.
3. CRC-LTD (FTMS 348.2) - TO EVALUATE DEPOSIT FORMING TENDENCIES UNDER LOW AND MODERATE OPERATING CONDITIONS (STOP AND GO) : 80 HOURS TEST.
4. SHEAR STABILITY (CEL-L-14-A-79) - TO EVALUATE SHEARING RESISTANCE OF MULTIGRADE OILS : 30 MINUTES RIG TEST
5. HOMOGENEITY AND MISCIBILITY TEST (FTMS 3470) - TO EXAMINE THE COMPATIBILITY OF THE OIL WITH PREVIOUSLY QUALIFIED OILS : 25 HOURS.

LINE DIAGRAM OF KIRLOSKAR SUPERCHARGE BENCH



installed. Test bench was commissioned after test for mechanical soundness. Clearances between piston and liner were modified. The test with REO-191 gave comparable performance with the one obtained earlier on experimental engine.

Results are compared in Table. A line diagram of supercharged test engine is shown in Figure.

Kirloskar Sup Engine Bench Results on REF Oil REO- 191

TEST NO.	8	9	MOD 1
PISTON SKIRT	10	9.84	9.90
UND/CRON	6.80	8.38	9.95
LAND AV	7.97	8.19	7.91
*GROOVE Wt AV	9.39	9.51	8.10
**OVERALL MERIT	8.54	8.97	8.97

Note : Ref. oil REO-191 is the calibrating oil for caterpillar 1H2

$$*\text{GROOVE WTD MERIT} = \frac{2 \times \text{AV CARBON} + \text{AV LACQUER}}{3}$$

$$**\text{OVERALL MERIT} = \frac{\text{SKIRT} + \text{GROOVE WTD} + \text{UC} + \text{LAND AV}}{4}$$

REO 191 PERFORMANCE	
AV MERIT	8.82
Sd. Div	0.24
80% Con.	~0.36
RANGE	8.46-9.18

Development of 2T Oil Test Methods

Performance test on indigenous Bajaj Super two-stroke engine for evaluation of 'Preignition' tendency of TS-B 2T oils was developed. For this, the test engine, test fuel, oil/fuel ratio, test operating conditions were standardised and the test procedure was finalised.

Repeatability and discriminating ability of the test method was established by conducting tests on CEC reference oils, marketed 2T oils, motor oils and indigeous 2T oil formulations. Results obtained on CEC reference oils by this method are satisfactory and comparable with those obtained on CEC Vespa 180 ss preignition test. (Table).

Alternative Fuels

Demonstration Project on Dual-Fuel Operation of Diesel Vehicles with Alcohol : Phase II -Ethanol

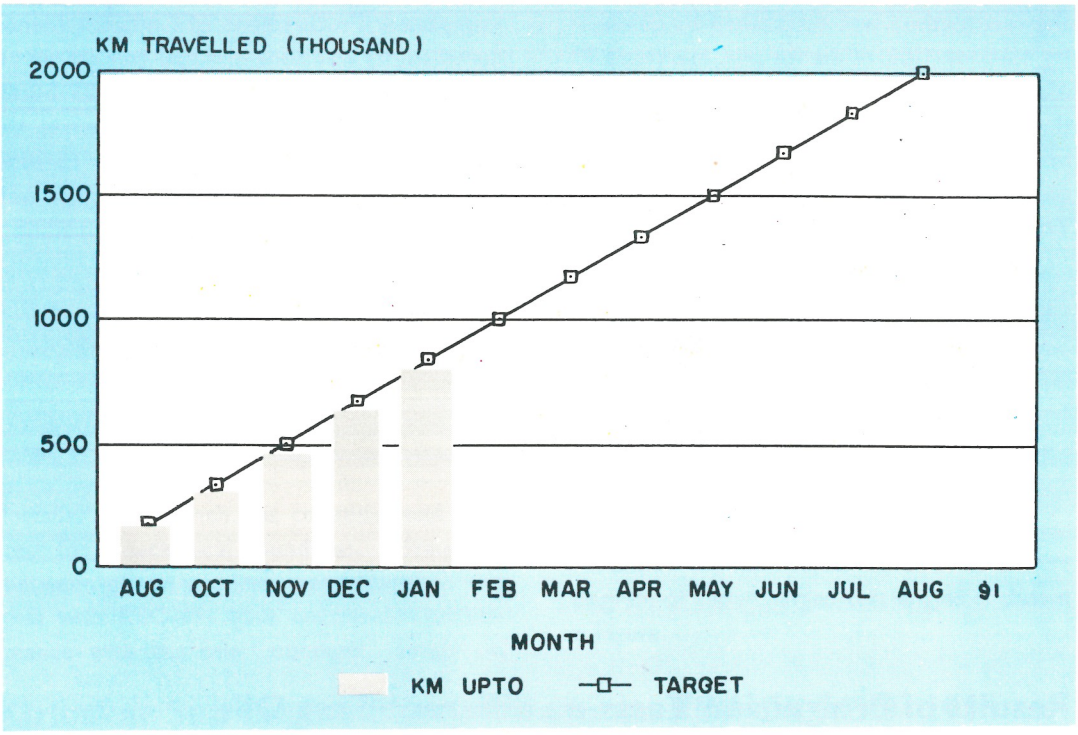
Laboratory trials on optimisation of the dual-fuel system for ethanol and fabrication of retrofit system for 25 Leyland buses were completed. Procurement of ethanol (denatured spirit) was done and fuel was stored at DTC Mayapuri Depot, New Delhi. 25 buses of this depot were converted to operate on dual-fuel system replacing about 15-20% diesel by ethanol. Training of DTC staff was also conducted. The buses started operation

Results of Preignition Tests on different Test Oils

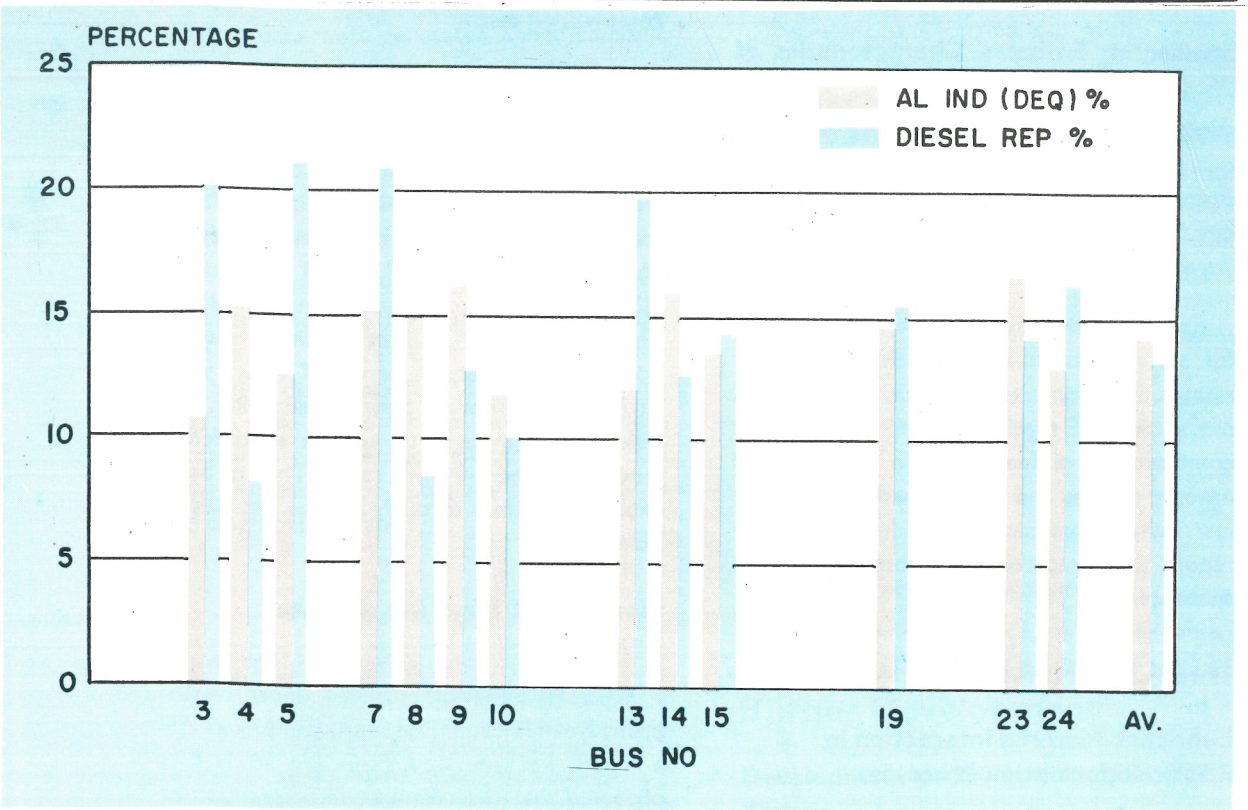
Oil Code No.	Description	Nos. of Test	Nos. of Preignition
	CEC Low Ref. Oil	4	5 to 6
	CEC High Ref. Oil	2	Nil
A	Marketed 2T Oil	2	Nil
B	HD-30 type I	1	2
C	Experimental 2T Oil Formulation	2	Nil
D	- do -	1	Nil

from August-September 1990, out of these 5 buses have engines, on the critical components of which, full measurements were carried out. Till January 1991, the buses have completed more than 5 lakh Kms (Figure) without any major operational problems and with average alcohol induction rates (diesel equivalent) of 9-11%. Back-to-back trials were also conducted in which alcohol induction varied from 13-15% (Figure). Analysis of oil samples were also carried out for each bus.

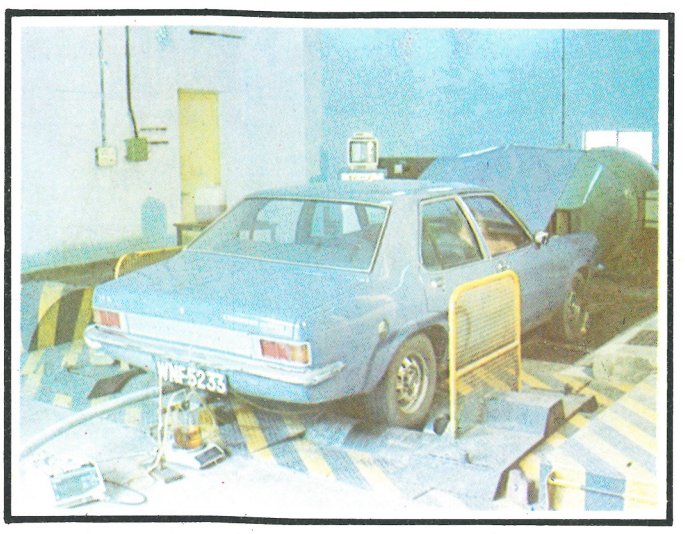
DEMONSTRATION TRIALS STATUS JANUARY 1991



BACK TO BACK TRIALS



Mass Emission tests on passengers cars



Vehicle Emission Studies

Mass Emission Characteristics of Passenger Cars

Mass emission characteristics of passenger cars as per Australian Design Rule (ADR) 37 driving cycle were measured for export of vehicles to Australia by the sponsors.

In the second study, optimisation of different designs of carburettors, intake manifolds and distributors for reduction of mass emissions were carried out on passenger cars on Indian Driving Cycle.

Optimized combination out of 12 different combinations of carburettors, intake manifolds, and distributor was tested, which showed reduction of CO by 43%, HC by 24%, but NO_x remained practically unaffec-

ted. The final report was submitted to the sponsors.

Studies on Emission Characteristics of Diesel Engines

Two tractor diesel engines were evaluated for mass emissions of CO, HC and NO_x. Exhaust mass emission were measured as per ECE 13 mode cycle. The final report was submitted to the sponsors.

An automotive truck engine was evaluated for mass emission at three different power ratings. Emission measurements were carried out as per ECE regulations R 49 using various combinations of fuel injection pumps and injector nozzles and a combination that gives low exhaust emissions was identified. The report was prepared and submitted to the sponsors.

INDUSTRIAL TRIBOLOGY

Lubricant-Material Interaction in Plastic Deformation Processes

Literature survey was carried out. It reveals that not much information particularly on interaction aspects is available. The interfacial friction under various operating conditions was estimated using Male's model for ring compression. The compression platens and specimen were fabricated for the ring compression test.

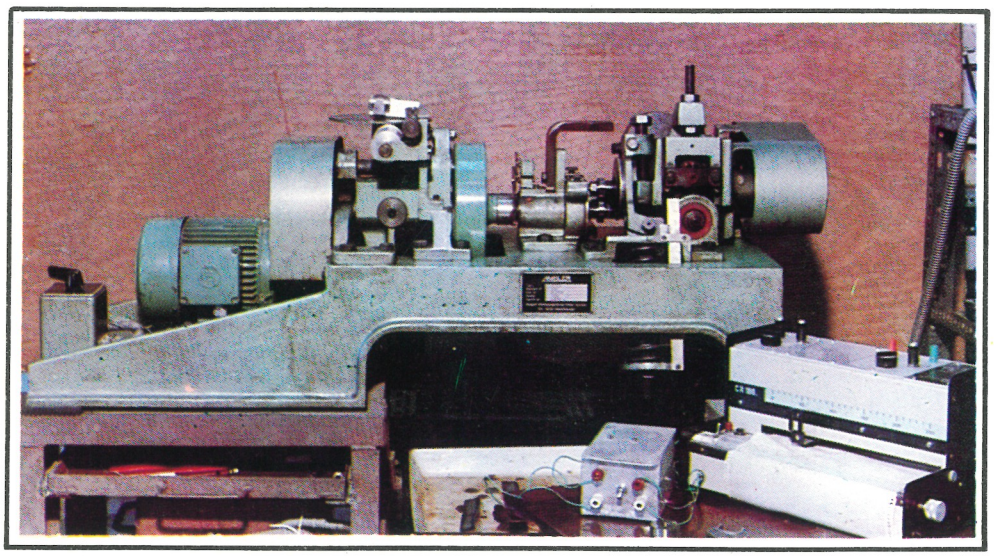
Studies on Running-in Wear of Piston Liner Materials

Further work on separation of running-in wear and steady state wear was done on disc machine. Experiments with two materials combinations of CI vs CI and CI vs Al under different sets of conditions were completed. The results with CI-CI combination showed better repeatability in terms of wear, while CI-Al results showed poor repeatability. The difference is thought to be due to different modes of wear in two cases. This is being explored further through surface studies in SEM.

Modelling of Wear in Lubricated Contacts

Wear investivations planned under plasto-hydrodynamic conditions were completed and a report was prepared. From the study it is observed that the chemical decomposition of the lubricants and phase transformation of surface layers can take place and both influence wear.

Photomicrograph of EN 31 shows transfer



Amsler Disc Machine

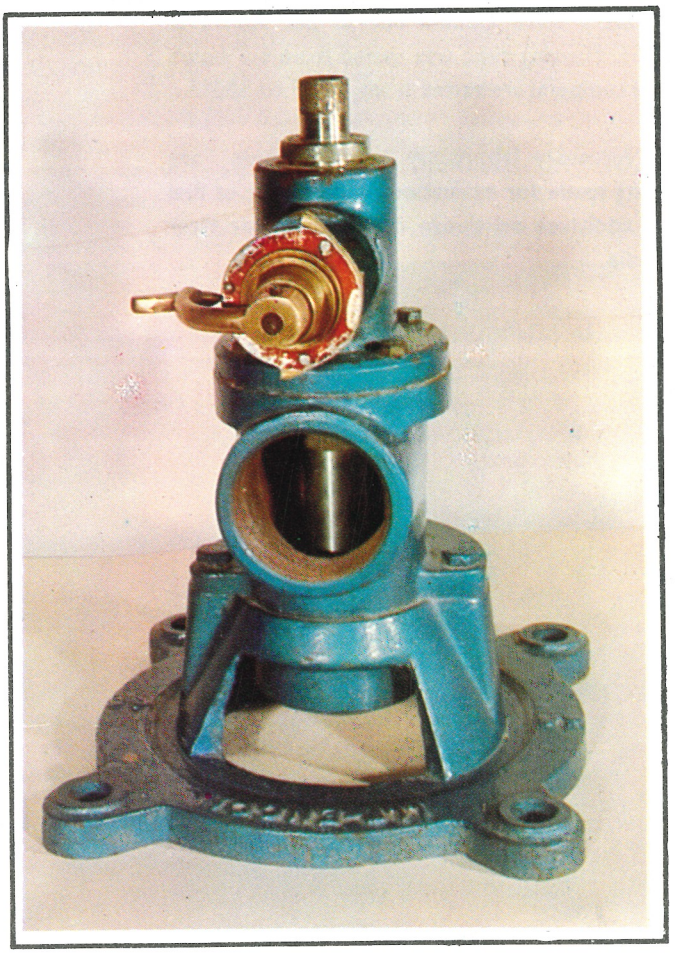
of wear material from mild steel surface (mag x 480).

Wear data were generated under different rolling/sliding conditions. Experiments are being conducted to study the wear mechanism using scanning electron microscope.

Studies on Mechanism of Action of Friction Modifiers

A test method for evaluation of friction modifiers required for engine oil is being devised on Amsler Disc machine, using simulated disc material combinations. For this, a wide range of test parameters were taken into consideration and the results are being examined for establishing repeatability and discriminating ability.

Industrial Film Burner



Studies on Aqueous Oil System as Cutting Fluid

The work was carried out with several compounds, having different chemistry and an aqueous oil was formulated. The performance of this oil was evaluated on various laboratory test rigs including drill test and compared with that of commercial oil. The aqueous oil performed better on all laboratory test rigs except the drill test. The EP characteristics of aqueous oil did not show much improvement with addition to sulphur and chlorine components.

INDUSTRIAL AND DOMESTIC COMBUSTION

Burner Development

Development of 200 kg/h Capacity Film Burner

Using second prototype of the burner cold model studies with water were completed. Good atomisation was observed at 96 l/h water through inner passage and 100 l/h through outer passage.

The burner was installed in a large furnace. Preliminary trials were conducted with HSDO. Due to better eccentricity, well suspended flame has been achieved. 30% excess air could be used at 198 l/h firing rate. Performance studies with fuel oil are in progress.

Development of Kerosene Laboratory Burner

Two modified prototype burners based on the design developed at IIP were fabricated and tested, It is found that the burning is good with blue flame at 100°C flame temperature at 65 gm/h kerosene consumption.

Domestic Appliances Development

Improvement of Nutan LPG Stove

Studies on marketed Nutan LPG stoves have been completed. Heat distribution of existing models was carried out. Fabrication of improved design of mixing tube, mixing chamber and burner head has been completed. Improved stove has 70% thermal efficiency.

Industrial Appliances Development

Development of Incinerator for Acid Sludge

An electrically operated sludge stirring system was fabricated and installed in the incinerator. A few trials were conducted for optimisation of various parameters.

Studies on Furnace Oil

Comparative Study of LSHS and HV Grade Furnace Oil

Experimental trials on IIP furnace using IIP Film Burner at 60 kg/h burning rate with both the fuels were conducted and flame characteristics were compared.

It was observed that in case of LSHS, flame temperatures were higher, emissivity was lower and zonal heat transfer higher along the furnace length. This may result in higher heat output if loading pattern is modified.

State-of-the-Art on use of Water in Fuel Emulsions as Fuels in Industrial Burners and Furnaces

A state-of-the-art report on use of water in fuel oil emulsions in industrial burners and furnaces was prepared. Water in fuel oil emulsions is a possible replacement for fuel in the industrial burner and furnaces. The report on the subject was prepared and submitted to the sponsors.

Evaluation of Fuel Oil Additives

Development of Facilities for Evaluation of Fuel Oil Additives

Studies on thermal stability of visbreaked tar of imported crude received from Mathura Refinery were carried out as per ASTM D 1661. Heating time was varied from 6-7 hours and temperature varied from 350°F to 380°F.

Necessary laboratory arrangements are being made for evaluation of the effect of fuel oil additives on sludge deposition over filter media.

AREA III

CHEMICALS AND INTERMEDIATES

CHEMICALS AND INTERMEDIATES

Additive Process Development

Octylated Diphenylamine

Isobutylene oligomers were synthesised and attempts made to alkylate diphenylamine with different isobutylene oligomers. Transalkylation of dioctyldiphenylamine with diphenylamine and effects of agitation rate on product yield were studied. Work-up procedure for separation of mono-and dioctyldiphenylamine was worked out.

N, N'-Di-Isopropyl-p-Phenylenediamine

N, N'-Di-isopropyl -p- phenylenediamine samples were prepared and, after fractionation, heart-cut was characterised. Status report has been prepared.

Butylated Alkylhydrocinnamates

A few exploratory experiments were carried out for preparation of butylated hydrocinnamic acid and its methyl ester using different catalysts and reference samples were prepared. Literature survey report was submitted to the sponsors.

Basic Studies

Etherification of Olefins Present in Cracked Petroleum Stocks

Etherification of C_8-olefins with methanol using different macroporous cation-exchange resins as catalyst was carried out in the 40-80°C temperature range. Pressure in the system was maintained so that a liquid phase is ensured at all temperatures. Olefins contining tertiary carbon were more reactive, whereas linear olefins under the conditions were unreactive. Products were analysed by GC and chemical methods.

Modelling and Simulation of Multiphase Reactors

Literature survey on trickle-bed reactors was carried out. Two computer algorithms were developed for the design and performance evaluation of trickle-bed reactors. The first one is a basic programme for plug-flow conditions, in the second axial-back mixing was also taken into account. The programmes were tested using literature data on HDS.

Specialty Chemicals

Synthesis of Specific Chemicals for Modification of Wax Crystal Morphology

Several copolymer compositions containing stack-type molecules have been identified which show promise as flow-improvers. Some of them displayed good wax-dispersion characteristics as well. Preliminary screening of the products for their flow-improver characteristics in commercial diesels has been completed. Evaluation by IOC is in progress.

C_{30}, C_{34} and C_{38} symmetrical *trans*-olefins have been successfully converted into their corresponding primary alcohols (yields > 90%).

Specialty Products

Process Development for White Oil/Liquid Paraffin

Laboratory evaluation of two different MRL base stocks for the yield of light-and medium-viscosity white oil/liquid paraffin conforming to IS and Indian Pharmacopia specifications has been completed. The yield of various products is given in Table.

The conditions for purification of crude sodium petroleum sulphonates, obtained as by-product during all treats, have been optimised. Complete analysis and equivalent weight determination of both the purified sulphonates have been carried out. Sulphonates obtained are a good source of emulsifiers, detergents and rust inhibitors.

Optimisation studies were carried out for reducing the number of oleum and neutralization stages for preparing white oil/liquid paraffin of low- and medium-viscosity from respective base stocks. The study has led to development of a more economic process for the manufacture of white oil/liquid paraffin on the commercial scale.

Oleum Consumption and Yield of Products

No.	% wt on Base Stock	
	light viscosity	Med. viscosity
1. Oleum consumed	48.2	49.80
2. Yield of white oil	62.0	33.30
3. Yield of Sodium Petroleum Sulphonates	10.4	27.30
4. Acid Sludge	66.3	72.00

Studies on Friction and Wear Reducers for Improved Engine Performance : Phospho-Sulphurised Derivatives of Fatty Acids, Alcohols and alkylphenols

Reaction conditions for the preparation of the following are being studied

— Lauryl, Cetyl and oleyl oleate.

— Molybdenum derivatives of pentadecyl phenyl phosphorodithioates.

— Alkyl and alkyl aryl phosphates, phosphonates and phosphinates.

Biomass Conversion to Hydrocarbons and Chemicals

Introduction, Screening and Cultivation of Potential Petrocrops and their Conversions to Petroleum Hydrocarbons

Laticiferous (2) and resinous (2) species were evaluated for their biocrude potential. One of the resinous species appeared to be attractive with biocrude yield of 13.3%

Spectral studies and physico-chemical properties of 12 biocrude samples revealed the absence of aromatics and the presence of oxygenates in the form of ketones, esters and alcohols.

Liquid fuels, obtained by conversion of 12 biocrude samples in MAT FCC unit using XL 70 E catalyst reported earlier, were studied for their spectroscopic and physico-chemical properties in order to evaluate the quality of the liquid products.

The FCC studies carried out with 12 biocrudes under ASTM conditions revealed that the reaction conditions were severe resulting in high yields of gases, coke and low-boiling products. The only exception was the biocrude from *Euphorbia antiisypphilitica,* which gave the highest conversion to liquid fuels, the yield of gases and coke were only 0.5 and 5.2% respectively. For optimisation of reaction parameters, therefore, the biocrude from *Pedilanthus tithimaloides* was studied under the following conditions :

Temperature : 430-480 ± 2% °C

Catalyst/feed : 2-3

Reaction period : 60-75 sec.

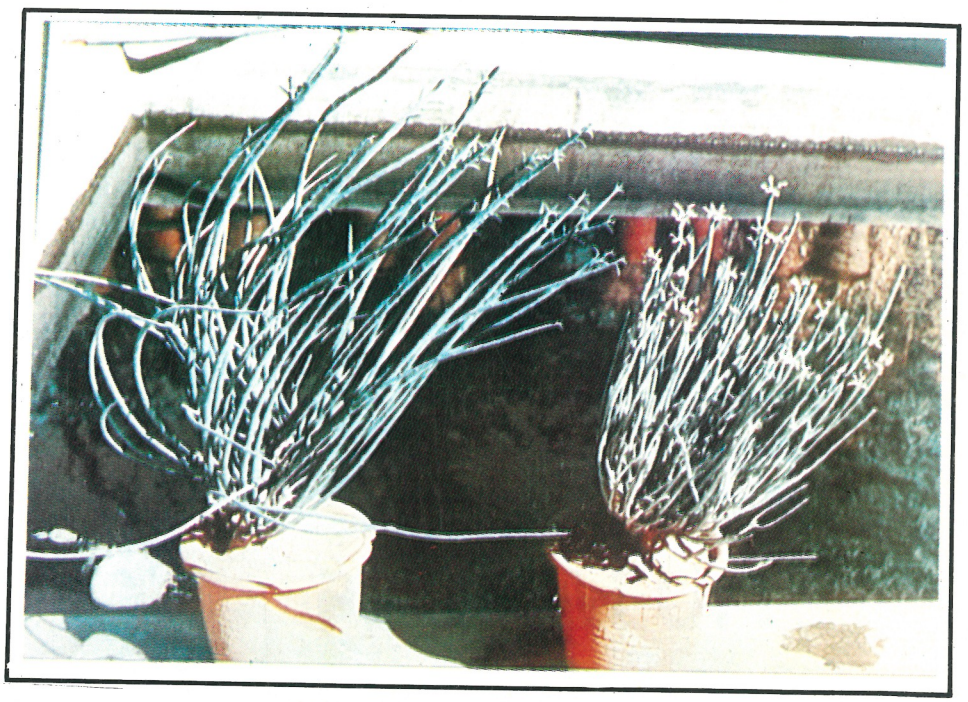
15 Biocrude samples have been studied under the optimised conditions.

To avoid the use of xylene as solvent during FCC and to explore the possibility of processing naphtha extract of biocrude

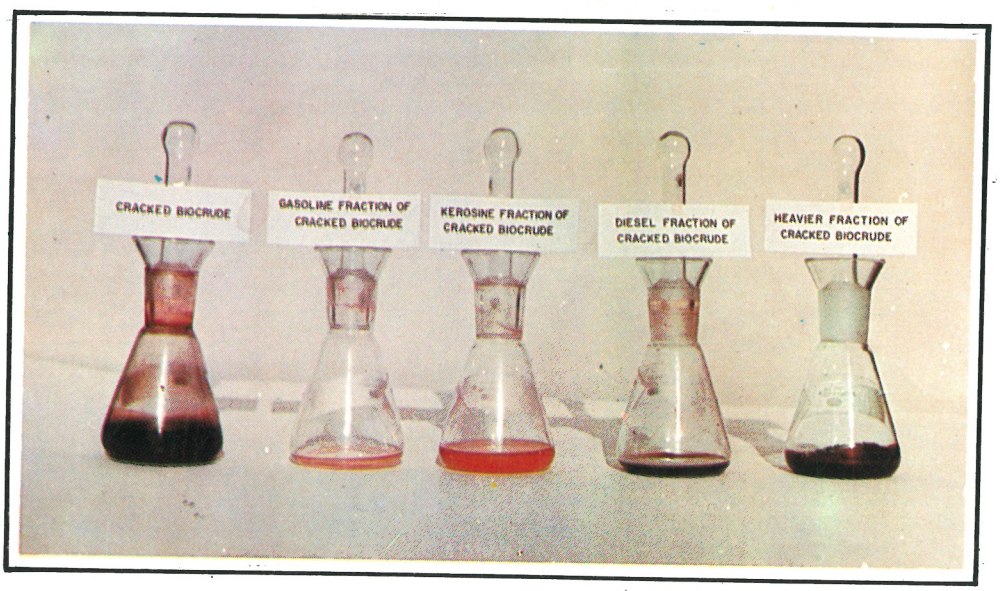
directly, studies have been carried out with *E. antisyphilitica* biocrude. Conversion using high concentrations was not possible because of solubility problem.

Proximate chemical analysis such as solubility, cellulose and pentosan percentage of *Euphorbia antisyphilitica* spent biomass has been carried out to explore its possible upgradation to useful products.

A proposal for a pilot plant production of liquid fuels from energy crop (capacity 1 ton/day) was prepared at the request of the DNES and submitted.



Three Year Growth of E. Antisyphilitica a) Irrigated Conditions, absence of Flowering b) Unirrigated Condition (Rainfed) Reduced Vegitative Growth with Increased Latex Content and Flowering



Products from Cracked Biocrude of Euphorbia Antisyphilitica

Utilisation of Jojoba Oil and its Derivatives for Lubricating Oil Formulations

Reaction conditions were optimised for the single-step conversion of joboba oil into long-chain (C_{18}-C_{24}) saturated alcohols by high pressure catalytic hydrogenolysis over commercial copper chromite catalyst.

Preliminary studies have been carried out for the preparation of jojoba oil estolids using various alcohols and carboxylic acids through alcoholysis and acidolysis respectively with a view to reducing the pour point of jojoba oil.

Studies have been initiated for the preparation of long chain jojoba amides to be evaluated as corrosion inhibitors.

A consolidated report on "Utilisation of jojoba oil and its derivatives for lubricating oil formulation -phase II" was prepared and submitted to the sponsor.

AREA IV

PETROLEUM BIOTECHNOLOGY

PETROLEUM BIOTECHNOLOGY

Laboratory and pilot plant facilities created at Gujarat Refinery premises during 1970 for conducting process development studies for the production of single cell protein from hydrocarbon and other carbon substrates was closed down in April 1990. During this period the following processes were developed.

— Separation of n-paraffins from kerosine/ diesel fraction by urea adduction.

— Microbial dewaxing of kerosine/diesel fraction.

— Single cell protein from n-paraffinic hydrocarbon, industrial alcohol, molasses etc.

— Treatment of citric acid effluent and simultaneous production of single cell protein for cattle feed.

The deal for the disposal of main fermentation unit and biomass treatment unit has been finalised with GSFC, Baroda and the complete unit is to be shifted from the refinery premises.

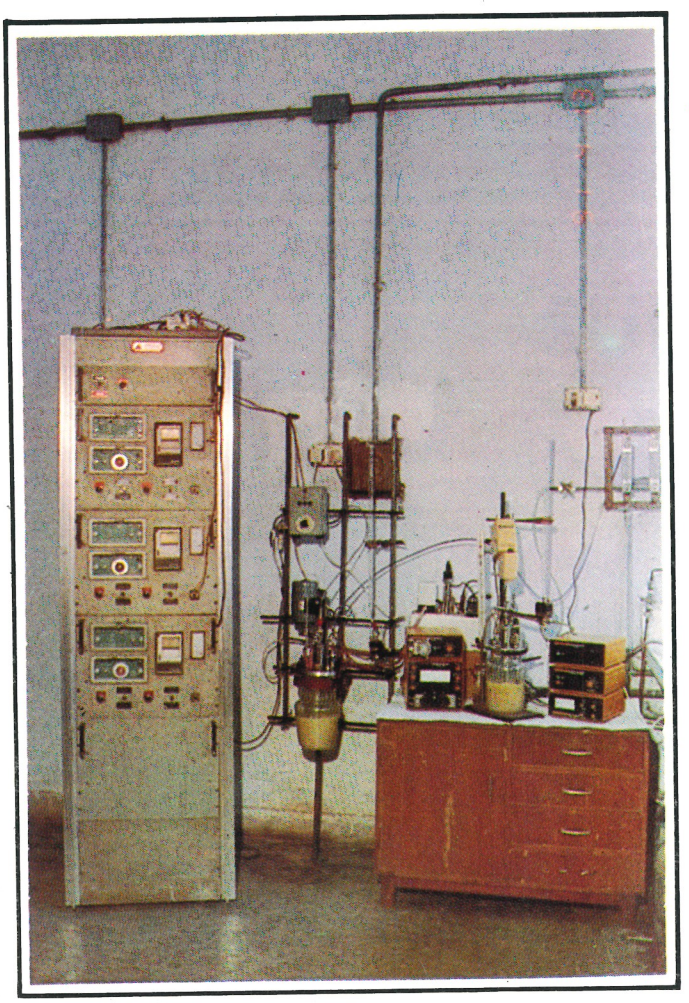
Laboratory facilities have been created at IIP Dehradun and the following two projects taken up at Baroda are being pursued.

Microbial Dewaxing of Heavier Petroleum Fractions

Fermentation studies with vacuum distillates ranging between 350-500°C produced at Barauni and Haldia refineries are in progress with a view to develop a process which can replace the existing energy intensive solvent dewaxing process. Figure shows microbial dewaxing of vacuum distillate.

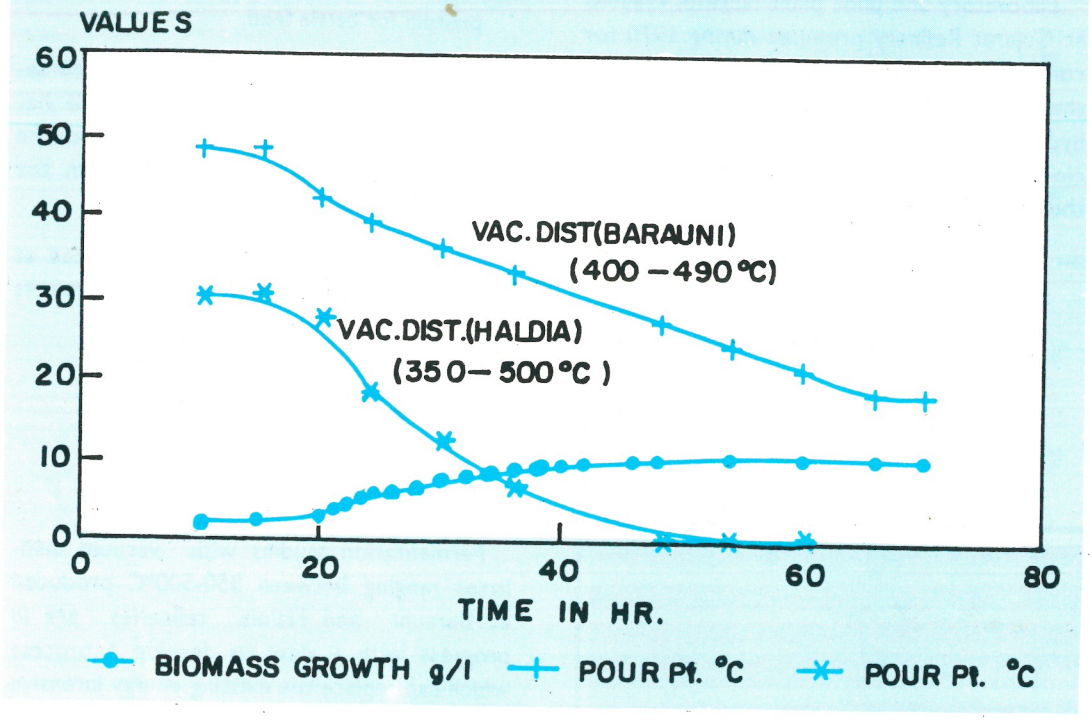
Single Cell Oil Microbial Lipid

An average coloured yeast strain belonging to Rhodotorula species has been adapted to grow on glucose and hydrocarbon. The effect of conducting fermentation in the nitrogen limiting condition on lipid production are in progress.



Bench Scale Fermentation Set-up for Microbial Dewaxing of Heavier Petroleum Fractions

MICROBIAL DEWAXING OF VACCUM DISTILLATE



SUPPORT SERVICES

SUPPORT SERVICES

INSTRUMENTAL ANALYTICAL TECHNIQUES

IIP is equipped with a number of modern sophisticated analytical instruments to cater the analytical needs of various inhouse R&D programmes as well as to provide services to external agencies, research organisations, refineries and petrochemical industries. Besides generating analytical data, scientists working on these techniques are also engaged in developing and standardising new and specialised analytical methods for process development work.

Gas Chromatography

A GC method was optimised for evaluation of products obtained by transesterification of jojoba oil with short chain alcohols. GC methods were standardised to monitor the synthesis of specialty chemicals, various monomers namely acrylates, vinyl esters, vinyl ethers and dialkyl and allyl ethers derived from various primary alcohols and fatty acids.

A rapid GC procedure for quantitative estimation of N-methylpyrrolidone in extract and raffinate phases in lube oil extraction process has been developed. The method uses back flush technique and is based on internal standardisation using tetralene as reference compound. Use of FID and TCD system enabled to cover wide concentration ranges (trace to high percentage of NMP).

Analytical inputs were provided during pilot plant studies on raw hexane-NMP system at HPCL Bombay.

Around 600 samples were analysed related to various inhouse and sponsored projects.

UV Spectroscopy

An UV method was developed to screen out aromatic classes mono-, di-, tri-, and tetra nuclear types in heavy alkylated bottom samples.

Atomic Emission/Absorption Spectrometry

Estimation of trace metals in crudes (North Gujarat, Dubai, Assam Mix, RAVVA-10 and RAVVA-17) and various petroleum products was undertaken related to sponsored and inhouse projects. , Around 108 sample elements were evaluated.

Mass Spectrometry-Gas Chromatography

For replacement of older SO_2 extraction technology of kerosene, Digboi refinery required detailed characterisation of 10°C and wider cuts of kerosene in boiling range 140-300°C. High and low eV mass spectra of 19 samples and their aromatic concentrates were scanned to provide detailed hydrocarbon analysis and carbon number distribution. Around 85 samples were analysed related to various sponsored and inhouse projects.

Infrared/NMR Spectrometry

Around 300 samples were analysed using IR and NMR related to various sponsored and inhouse projects.

The following studies were undertaken :-

— IR and NMR studies of heavy Arab Mix short residue and its visbroken products.

— Structural changes in lube base stocks during mild hydrotreating using NMR and IR techniques.

— IR studies of structural changes of zeolite during dealumination.

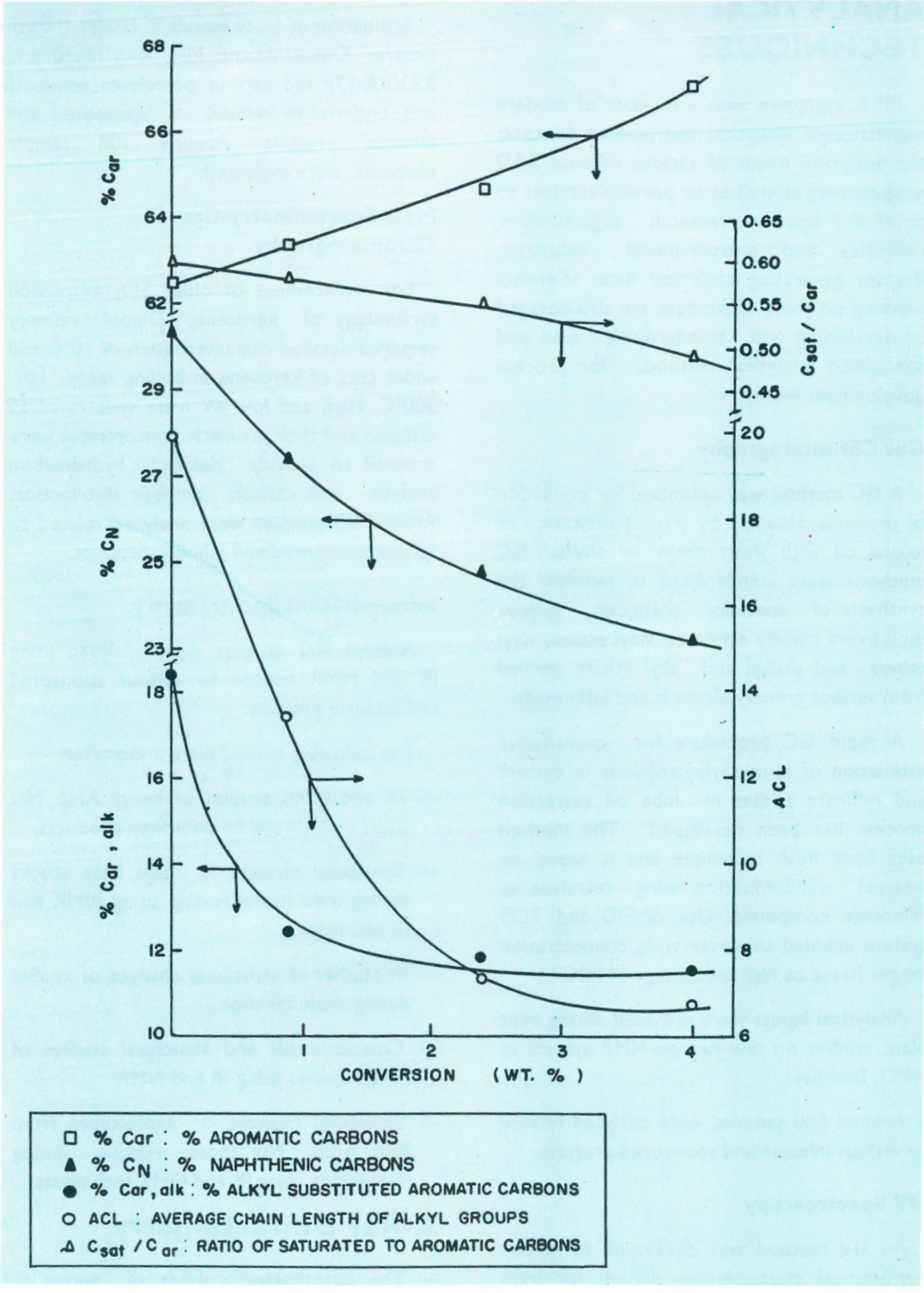
— Compositional and structural studies of HAB samples using IR and NMR.

— Structural changes in asphaltenes from light Arab Mix short residue during visbreaking using IR and NMR techniques.

X-Ray Diffractometry

— The quantitative analyses of waxes in

VARIATION OF A FEW STRUCTURAL PARAMETERS DERIVED FROM ^{13}C-nmr SPECTRA OF $^{n}C_5$-ASPHALTENES WITH CONVERSION.



asphaltene samples were done using both internal standard and direct comparison whereby the absorption correction was neglected. As the waxes tend to orient preferably, the intensity of (110) and/or (002) reflex at times does not remain proportional to the quantity of waxes present.

— The indexing of lithium-soaps from greases is being attempted. Since long chain compounds pose a peculiar problem as most of hk-lines group together to form a band.

— Determination of L_c and other parameters for petro-cookes was initiated. One sample was analysed for phase composition and crystallite size.

TECHNO-ECONOMIC FEASIBILITY STUDIES AND MARKET SURVEYS

Market Survey for Demand Forecasting of TOBS/TOFS and Spindle-HVI Oils

The study was undertaken at the instance of IOC, to establish the demand for transformer oil base stocks/feed stocks, spindle HVI oil and process oil N-505 and their products.

The following aspects have been covered :

— Demand for these specialty oils upto 1994-95 and perspective upto the turn of the century.

— Regionwise demand and availability patterns.

— Scope for new units for producing white oils, liquid paraffins and transformer oil.

— Norms of consumption.

— End use quality requirements.

— Sulphonate scenario.

— Technology and environmental aspects.

The work has been completed and report submitted to the sponsors.

Techno-Economic Feasibility Studies for Projects in the Area of Engineering Plastics

Five engineering plastics, namely PC, PET, PV, PVDF and SAN were considered for the study and the following aspects have been covered.

— Demand-supply balance

— Raw materials availability

— Basic building blocks

— End uses and quality aspects

— End product identification for project proposal

— Process details

— Process economics

— Prospects of selected engineering plastics in India.

The work has been completed and report submitted to the sponsors.

Techno-Economic Feasibility Study on Speciality Greases

The following specialty greases have been covered :

— Polyurea grease, 100 tpa capacity.

— Aluminium complex grease, 300 tpa capacity.

Both the projects appear to be attractive as the payout period, in each case, is around one year. These greases are suitable for high temperature lubrication applications in automotive and heavy industries.

ENGINEERING SERVICES

The following significant jobs were undertaken and completed :

— Erection and commissioning of liquid nitrogen plant.

— Induction of a Canter mini bus and a Tata bus in vehicles fleet.

— Erection of steam line in Combustion complex shed for furnace oil studies.

— Renovation of 2nd floor corridor for Report Preparation Cell.

— Preparation of plan, drawing & design and estimates for Squash Court.

— Drainage in and around combustion complex shed and auditorium.

In addition, general maintenance and repairs were provided by instrumentation, electrical, workshop, civil works, glass blowing, water supply, carpentry, refrigeration & air conditioning sections. Around 2690 job cards were handled by various sections during the year.

INDUSTRIAL LIAISON

Planning, monitoring, research coordination, industrial liaison, technology transfer, international scientific collaboration, organisation of seminars/workshops/conferences, publications, patents, publicity and public relations are some of the major activities of Industrial Liaison. All S&T activities of the institute are carried out in close coordination with this group.

Planning, Monitoring & Research Coordination

The research progress and future plan of work of the institute were discussed in detail in the Research Council meetings for its approval. Three such meetings were held during this year for which detailed agenda were prepared which included progress of research during last three months, work plan for the next three months, new project proposals and panel of experts for recruitments and assessments.

A detailed document on the plan of work during VIII plan period, keeping in view the scenario and requirements of the country for petroleum and related industries upto the turn of the century, was prepared and got approved by the Research Council. Monthly progress reports, quarterly research utilisation data, quarterly monitoring of milestones of selected mission and thrust area projects were prepared for the institute, CSIR and other agencies.

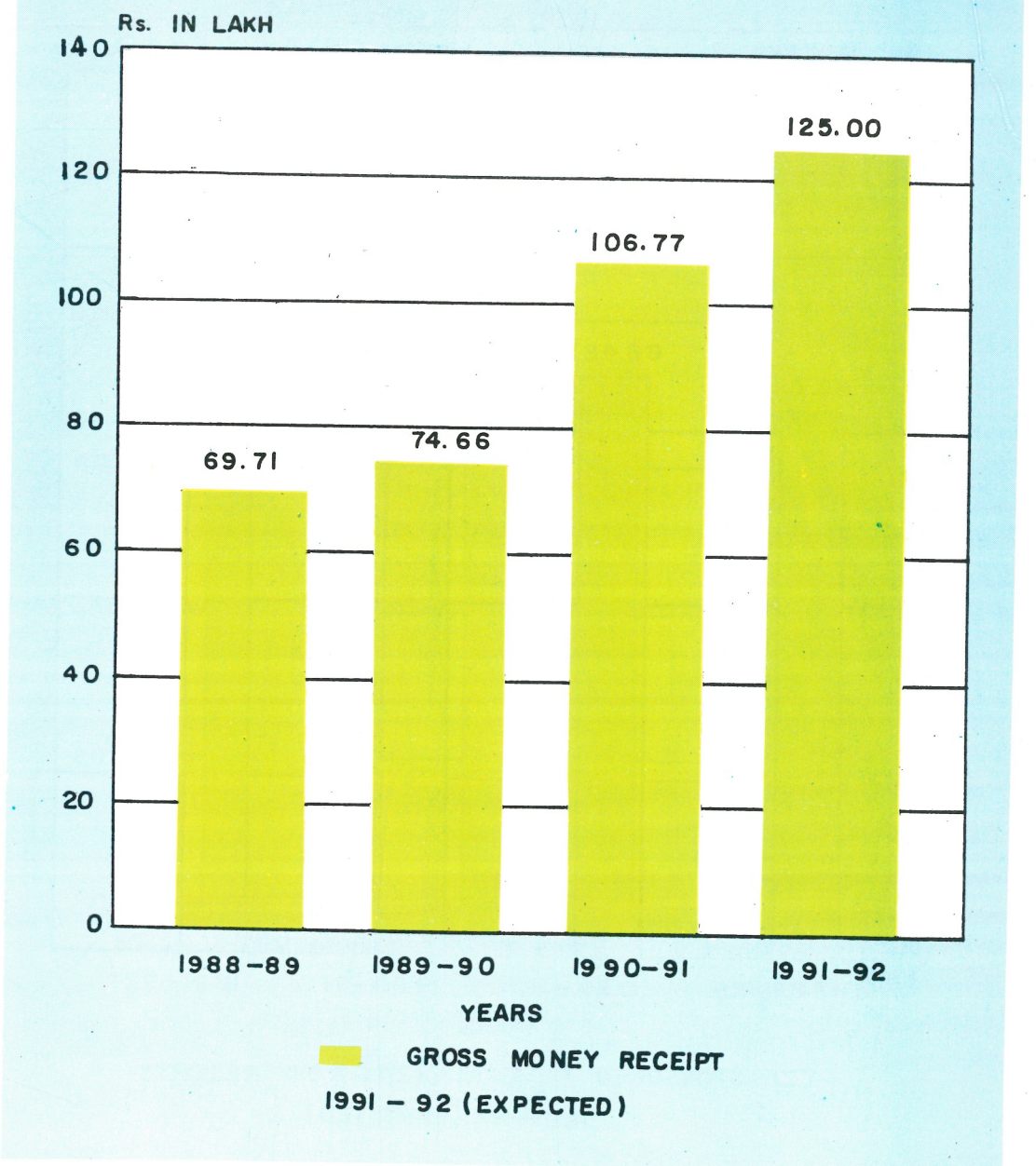
A meeting of Technology Advisory Board (TAB) of Chemical Sciences Group of CSIR laboratories was held on November 17, 1990. Professor M M Sharma, Director, Department of Chemical Technology, University of Bombay, and Chairman TAB (Chem) presided. Dr S Varadarajan also participated along with scientists from various laboratories. Several areas involving inter-laboratory studies were identified, discussed and finalised.

On the suggestion of DG, CSIR, TAB meeting for Biological Sciences was organised at IIP on October 14, 1990. Professor B K Bachhawat, Head, Department of Biochemistry, University of Delhi and Chairman, TAB (Bio) presided. Dr P K Ray, Director, Industrial Toxicology Research Centre, Lucknow and Dr S K Basu, Director, Institute of Microbial Technology, Chandigarh participated in the deliberations along with scientists of different laboratories. Mr D K Adhikari and Mr V S Saini, Scientists, IIP also took part in these deliberations.

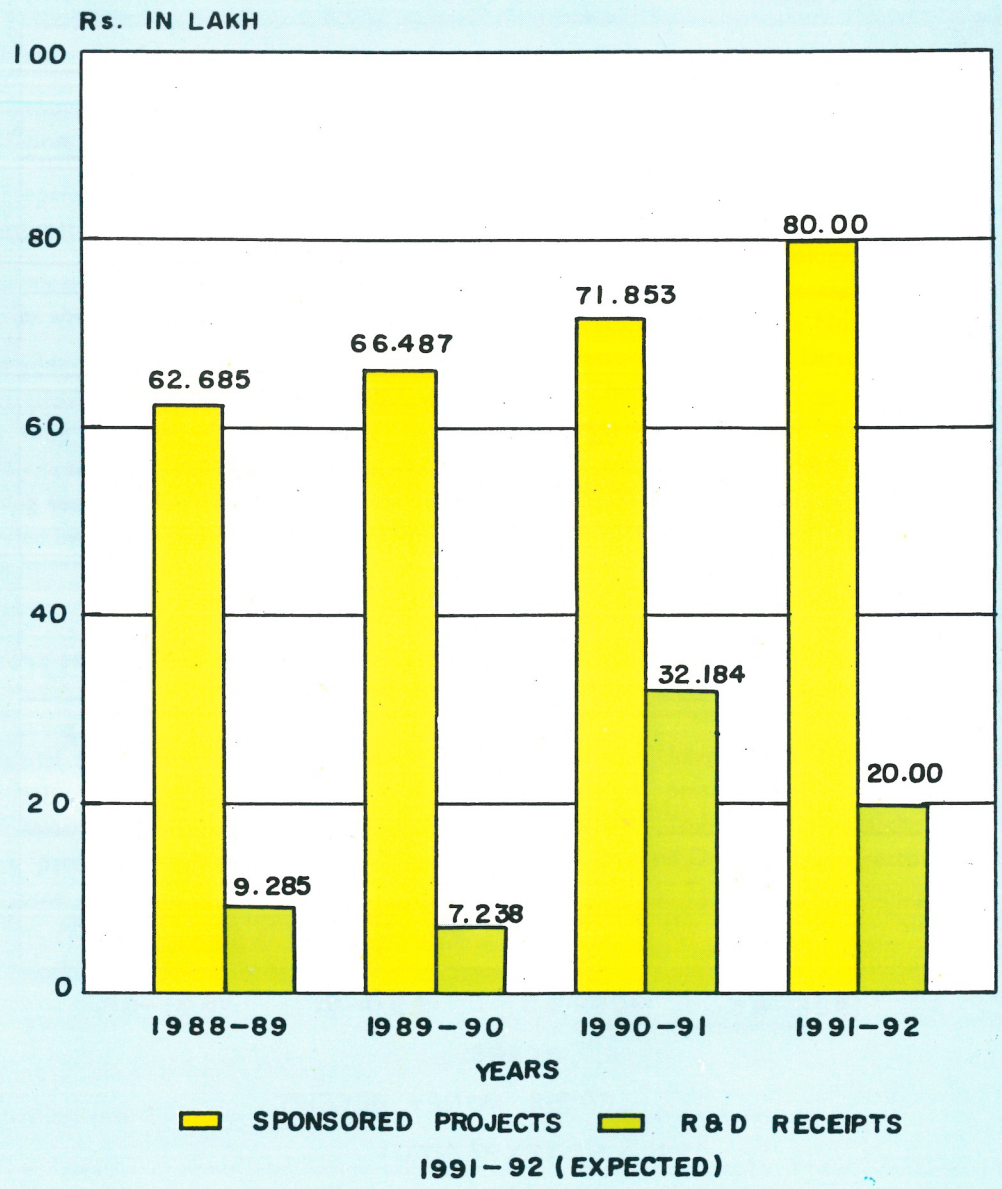
Interaction with Industries

The institute received nearly 3000 scientific and technical correspondence/enquiries from different private and government agencies. The enquiries were generally related to different technologies/ products developed in the institute, assistance required for various S & T activities, supply of information on petroleum and related matters as well as those concerning sponsored and collaborative work being carried out in the institute.

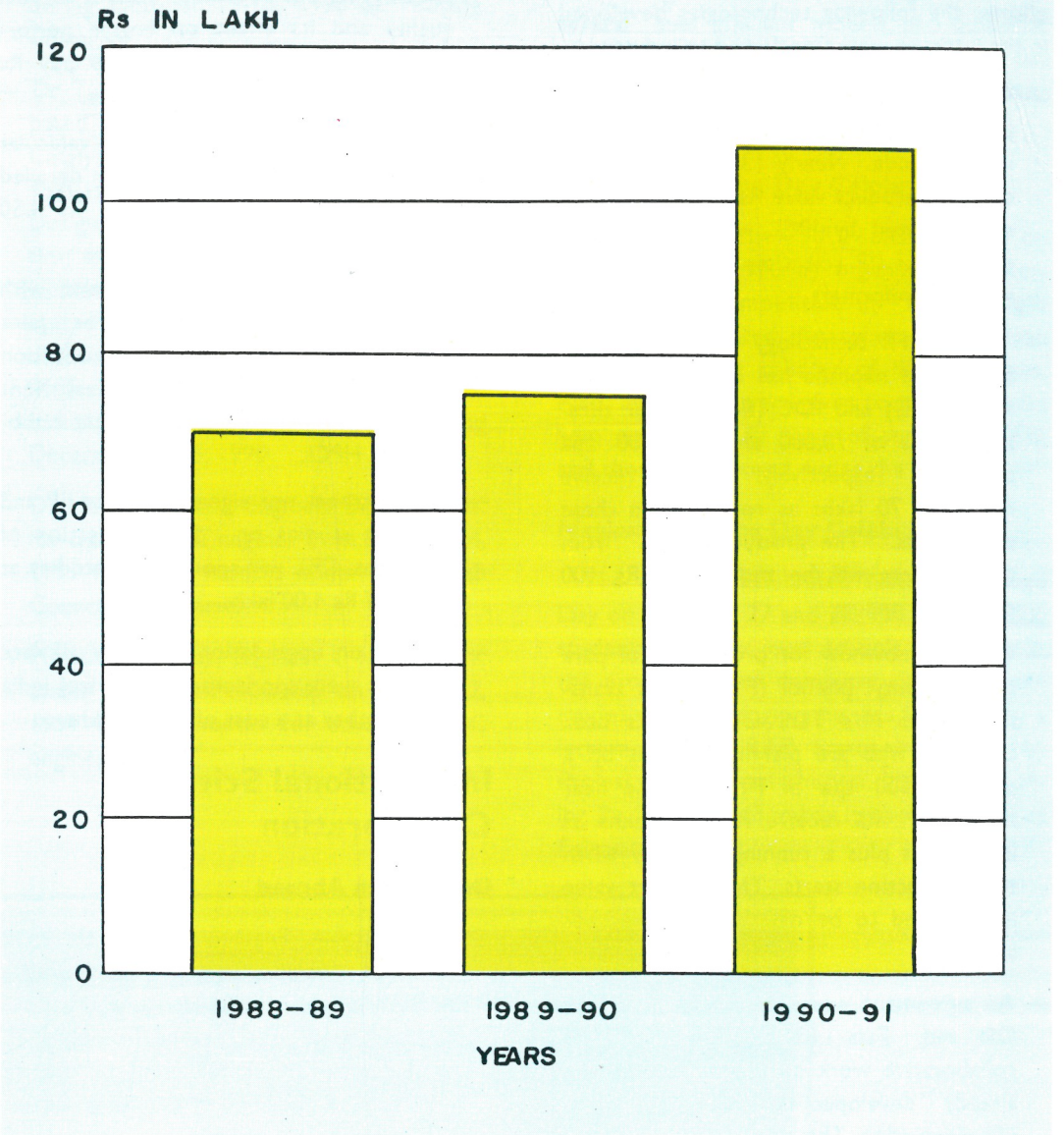
GROSS MONEY RECEIVED



EXTERNAL CASH FLOW



EXTERNAL CASH FLOW



Technology Transfers/Collaborative Agreements

As a result of continuous and vigorous efforts, the following technologies developed in the institute were transferred to industry :

— Pt-Re bimetallic reforming catalyst production technology was transferred to IPCL, Baroda. Nearly 13 tonnes of this catalyst (product value Rs. 4.2 crores) was manufactured by IPCL with active participation of IIP scientists for use at MRL and IPCL reformers.

— The IIP-IFP technology for catalytic reforming of naphtha has been licensed to IOC (AOD) and IOC (Barauni) for turnkey plants of 70,000 and 2,50,00 tpa capacities respectively. IIP will receive nearly Rs 70 lakhs as royalty from these two plants. The product value from these plants will be more than Rs 100 crores per annum.

— Process knowhow for production of para teritiary butyl phenol (PTBP) was transferred to M/s Tara Oils & Fats Ltd., Lucknow who are planning to put up a plant of 500 tpa of PTBP in the near future. IIP will receive Rs 4.5 lakhs as license fee plus a running royalty when the production starts. The product value is expected to be over Rs 5 crores per annum.

— An agreement was signed with M/s Tara Oils and Fats Ltd. Lucknow to do collaborative work on upgradation of the already developed technology for white oils production. This was required to meet stringent specifications which have come into force for this product. IIP will receive Rs 0.675 lakhs as license fee plus a running royalty after production.

— An agreement has been signed with M/s AEC (India) Ltd., Delhi for development of technology for production of two specific alkylated phenol based antioxidants. IIP will receive Rs. 5.5 lakhs for this development work.

— IIP has entered into agreement with the Centre for High Technology (CHT), and Ministry of Petroleum and Chemicals for carrying out detailed studies on fuel quality and its effect on engine performance and operation. CHT will pay Rs 51.25 lakhs as cost of these studies.

— DoE has entrusted IIP studies on vehicular emission and preparation of a detailed report on this. IIP will receive Rs 4.50 lakhs for this study.

IIP has entered into an agreement with HPCL, Bombay and EIL, Delhi for joint development of technology for production of aviation turbine fuel through solvent extraction of kerosene at pilot plant established at HPCL.

— An agreement was signed between IIP and CRL for studies on desulphurisation of fuel gases. CRL will sponsor the studies at a cost of Rs 4.00 lakhs.

— Studies on upgradation of heavy alkylate bottoms were sponsored by Lubrizol India Ltd. Bombay at a cost of Rs 3.0 lakhs.

International Scientific Collaboration

Deputation Abroad

— Mr S K Jain, Engineer EI and Dr Alok Saxena, Engineer C have undergone practical training on process design at Institute Francias du Petrole, France from July 23 to December 23, 1990. During the training they were exposed to latest design norms and techniques pertaining to petroleum refining processes. They also prepared process packages for different international projects related to hydrodesulphurisation, reforming and hydrogenation processes.

— Mr J M Nagpal, Scientist EI, visited Germany from September 2 to November 2, 1990 and worked on analysis of hydrocarbons and conversion of natural gas to liquid hydrocarbons through Fischer-Tropsch synthesis.

— Mr. S Singhal, Scientist F, attended the First Asia Pacific International Symposium on Combustion and Energy Utilisation during October 15-18, 1990 at Beijing, China.

— Dr T S R Prasada Rao, Director, participated in the International Workshop on Catalyst Design during December 11-13, 1990 and delivered an invited talk on Design, Development and Commercialisation of Zeolite-based Catalyst for Xylene Isomerisation at Trieste, Italy. He also visited University of Bologna and had discussions on mutual cooperation with Professor F Trifiro of Department of Industrial Chemistry and Materials during December 14-15, 1990.

— Dr Mukesh Saxena, Engineer EI, visited UK for training in IC engines from February 4, 1991 for three months under the British Council Programme.

— Mr Sudhakar Das, Engineer C went to UK under Boyscast Fellowship on March 22, 1991 for six months for studies on IC engines.

Participation in Exhibitions

IIP participated in CHEM-TECH 90 exhibition during October 6-12, 1990 and exhibited several fuel efficient models of domestic appliances and smoke meter developed at IIP. Mr N S Gurupada Swamy, Minister of Petroleum and Natural Gas, visited IIP/CSIR stall.

CSIR Foundation Day Celebrations

IIP celebrated the CSIR Foundation Day on September 26, 1990 by organising an inter-school quiz competition in which eight schools participated. An essay competition was arranged for children of IIP employees. Also, mementos were given to staff members who completed 30 years of service in CSIR and those who retired during the year.

National Science Day Celebrations

The institute celebrated National Science Day on February 27 and 28, 1991. About 200 students from six local schools took part in the programme on computer simulation and modelling. The programme was followed by a lecture titled "R&D Status in India" by Professor S C Bhattacharyya, Honorary Visiting Professor, IIT Bombay in the afternoon of February 28, 1991.

Professor S C Bhattacharyya delivering National Science Day lecture

IIP Foundation Day Celebrations

The Second Foundation Day Lecture was delivered by Dr S Varadarajan, Chairman, Consultancy Development Centre of DSIR and former DG, CSIR on April 25, 1990.

LIBRARY

The library, as a service-unit, continued its resource building activity along with providing consultation, loan and reference services. Apart from the institute's staff, the library was regularly consulted by scholars from local organisations and other institutions in the country, viz. universities, IITs, refineries and other R&D units. The library has an excellent collection on Petroleum Refining and Petrochemicals Engineering/Technology, Petroleum Products Application and related fields. During the year 252 books and 409 bound volumes were added making the total holdings to 14,343 books and 12,315 bound volumes. The library subscribes to 110 periodicals. To save space and remain upto-date, obsolete items are weeded out frequently. The consultation hours of the library have been extended upto 8 p.m. on working days and from 9 a.m. to 5 p.m. on Saturdays.

IIP FELICITATES PROFESSOR MM SHARMA, FRS

Professor M M Sharma

On November 17, 1990, a function was organised in the IIP auditorium to felicitate Professor M M Sharma, Director, UDCT, Bombay, on being honoured as a Fellow of the Royal Society and lately for winning the prestigious ICMA award instituted by the Indian Chemical Manufacturers' Association for his outstanding contributions to the chemical industry. Besides the staff members of this institute, senior scientists from CSIR, Directors of National Laboratories under Chemical Sciences Group or their nominees and experts of Research Council attended the function.

Library Journal Section

HONOURS/AWARDS/ DISTINCTIONS

IIP Gets CSIR Technology Award

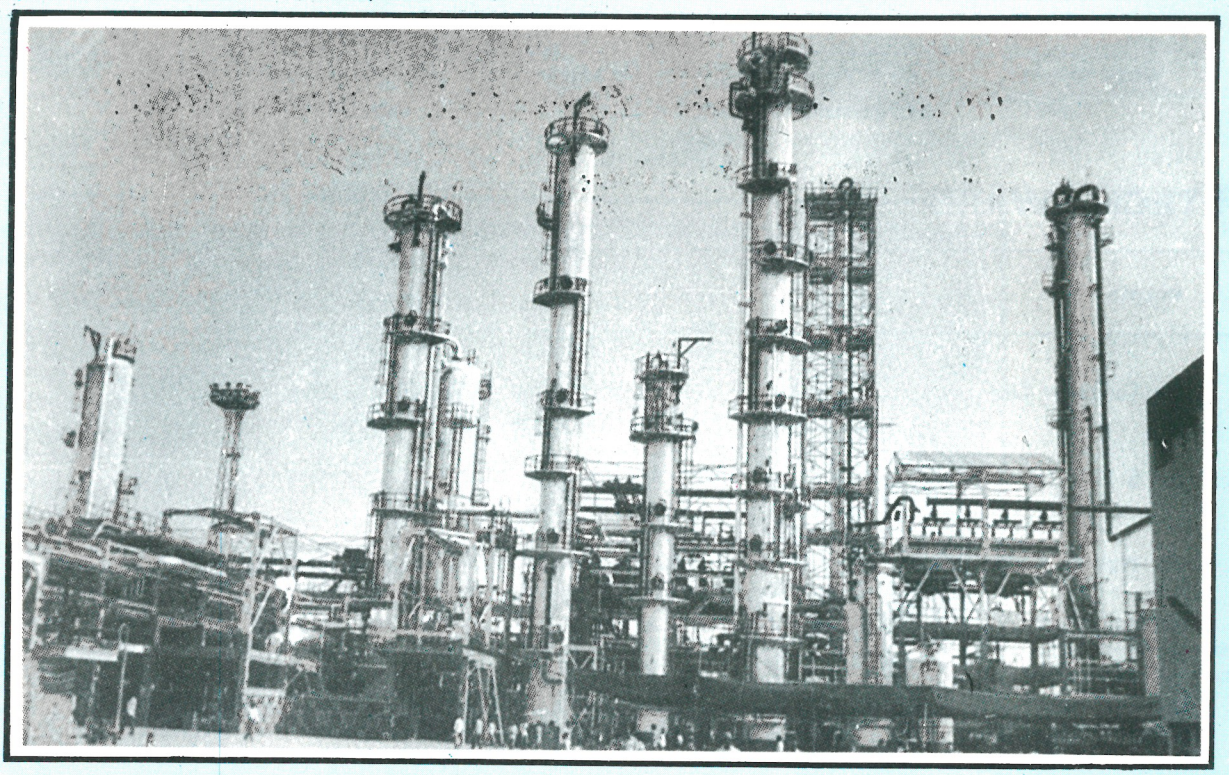
The "First CSIR Technology Award 1990" has been given to IIP for the development of an indigenous solvent extraction technology for the production of pure benzene and toluene. The award carries a citation and Rupees One Lakh in cash and has been shared with National Chemical Laboratory, Pune.

This indigenous technology has been developed jointly with Engineers India Ltd. The first plant with this technology was built at Bharat Petroleum Corporation Ltd., Bombay which went on stream in August 1985. The second unit was built at Cochin Refineries Ltd. which is in production since February 1989. Both these units are producing about 98,000 tpa each of pure benzene and about 2,000 tpa each of pure toluene. With this production, the country is saving foreign exchange worth Rs. 200 crores per annum in terms of product cost. It has also been offered to Haldia Petrochemicals, NAPCO, Madras and Salimpur aromatic complex.

This technology has been further extended for the dearomatisation of straight run naphtha to produce low aromatic naphtha suitable for naphtha cracker and fertilizer units. For dearomatisation, it has been offered to Haldia Petrochemicals, Mangalore Refinery and Petrochemicals, and Reliance Industries. The proposed total capacity of these units is about 6,40,000 tpa of straight run naphtha.

The technology has been developed by IIP and EIL. Dr B S Rawat leads the team consisting of Dr A N Goswami, Dr M K Khanna, Mr G S Dang, Mr J M Nagpal, Mr Shri Krishna Gupta, Mr Guru Prasad, Mr P C Gupta and Mr R S Kaushik responsible for the development of this technology.

IIP - EIL Aromatic Extraction Process Unit of BPCL, Bombay



Ph.D. AWARDED

	Name	Topic	University
1.	Mr Mathew Abraham	A study of Irregular Combustion, Misfiring and Cycle-by-Cycle Variations in Small Two Stroke Spark Ignited Engines	Roorkee
2.	Mr M P Kapoor	Composition and Structural Studies of Visbroken Residues With Reference to Their Stability	HNB Garhwal
3.	Mr Nipun Marwah	Study of Chemical Constituents of Parthenium Argentatum Gray	HNB Garhwal
4.	Ms Poonam Chaturvedi	Vinyl polymers with long pendant groups : Synthesis, Structure and a Study of Their Effect on the Flow Properties of Petroleum Fluids	HNB Garhwal
5.	Mr R C Purohit	Studies on Effect of the Composition of Petroleum Products on Its Low Temperature Flow Behaviour	HNB Garhwal
6.	Mr Mange Ram	Investigation of Asperity Level Conformity in EHD Lubrication	IIT Delhi

M TECH AWARD

	Name	Topic	University
1.	Mr Sudhakar Das	Prediction of Cylinder Flow Fluid Modification Due to Squish in DI Diesel Engine	Roorkee
2.	Mr S Maji	History of Hydrocarbons and Scavenging Losses in Two Stroke Engines	IIT Delhi
3.	Mr Mukesh Gupta	Computer Aided Analysis of Friction Losses in a Piston Ring-cylinder Linear Contact of an IC Engine	IIP Delhi

Distinctions

Mr V S Saini, Scientist has won the best presentation award in the technical session of Biochemical Engineering and Biotechnology of Indian Chemical Engineering Congress 1990 held at BHU during December 18-21, 1990 for his paper entitled "Studies on Microbial Dewaxing of Petroleum Fractions".

The PE Session of the V National Symposium on Mass Spectrometry held at Physical Research Laboratory, Ahmedabad during 7-9 January 1991 has awarded first prize (a merit certificate and cash award of Rs. 250/-) to Dr Pradeep Kumar *et al.* for their paper: "Characterization of Heavy Alkylated Bottoms by GC-MS Technique".

TRAINING COURSES ORGANISED

	Title	Participants	Duration
1.	Instrumental Analytical Techniques	M. Phil students from Roorkee University	March 28-30, 1990
2.	Petroleum and Petrochemicals Technology	15 Chem. Engrs. from Reliance Industries Ltd., Bombay	April 16- May 4, 1990
3.	Application of Fuels and Lubricants on Automotive Engines/Vehicles and industrial Lubricants	12 Mech. Engrs. from Hindustan Petroleum Corporation Ltd.	May 22 - June 9, 1990
4.	Training-cum-Workshop on Operation and Maintenance of Dual Fuel System and Its Safety Aspects	Project Team Working on Alternative Fuel	August 24, 1990
5.	Petroleum Refining and Petrochemicals Technology	21 Chem. Engrs. from Reliance Industries Ltd., Bombay	March 12-26, 1991

Mr N K Srivastava, Acting Director (Operations) HPCL inaugurating course for Reliance Industries Ltd. Chemical Enginers on March 12, 1991.

MAJOR FACILITIES CREATED

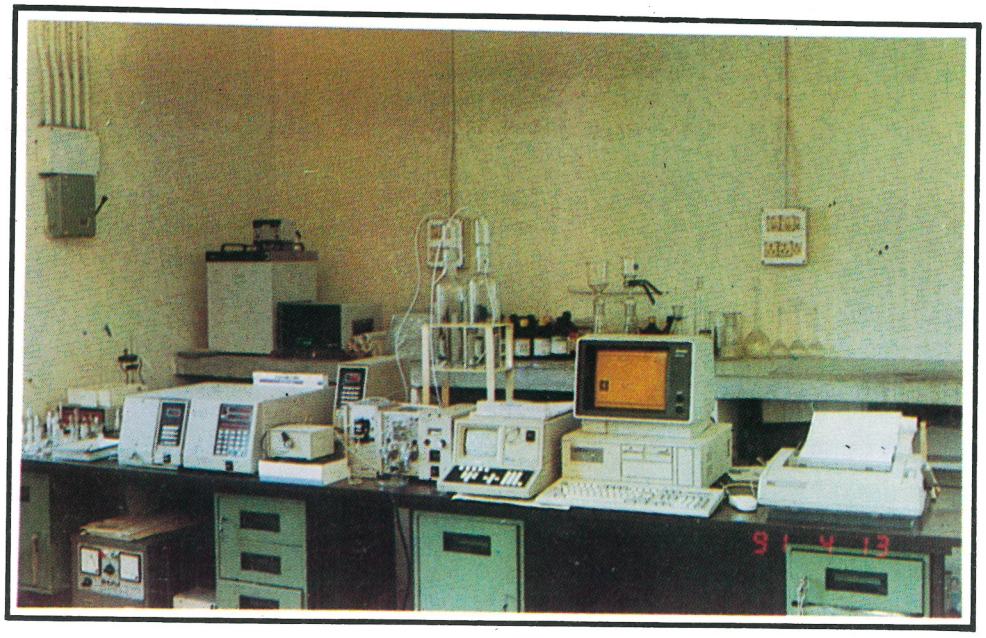
An additional Caterpillar Engine Test Bench has been set up with all accessories as per the specifications provided in the test method.

A Liquid Nitrogen Plant of Philips make with 7 l/h capacity has been installed.

High Performance Liquid Chromatography (HPLC) system comprising of Maxima 820, chromatographic work station with dual detector and fraction collector has been set up.

Du Pont Model 9900, Differential Scanning Calorimeter coupled with TGA/DTA for thermal analysis has been installed.

Liquid Nitrogen Plant



HPLC Unit

APPENDICES

LABORATORY COMMITTEES

Research Council

CHAIRMAN

Dr P K Mukhopadhyay,
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Faridabad 121 007

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Bombay

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CHAIRMAN

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Mr S M Nanoti,
Scientist C,
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Nominee of Director General, CSIR

Sr Finance & Accounts Officer,
Indian Institute of Petroleum,
Dehradun 248 005

SECRETARY

Controller of Administration,
Indian Institute of Petroleum,
Dehradun 248 005

आंतरिक समितियां

नियुक्ति समिति

डॉ० मैथ्यू अब्राहम	अध्यक्ष
श्री बिशम्भर दयाल वशिष्ट	संयोजक
डॉ० अजय कुमार भटनागर	सदस्य
श्री बसंत कुमार	सदस्य
डॉ० सतीश कुमार गोयल	सदस्य

प्रकाशन एवं पेटेन्ट समिति

श्री जी० बालमल्लया	अध्यक्ष
डॉ० प्रकाश चन्द्र नौटियाल	सदस्य
डॉ० अमर नाथ गोस्वामी	सदस्य
डॉ० अशोक कुमार गुप्ता	सदस्य
डॉ० प्रदीप कुमार	सदस्य

पुस्तकालय समिति

डॉ० गिरीश चन्द्र जोशी	अध्यक्ष
श्री दीन दयाल शर्मा	संयोजक
डॉ० आलोक कुमार सक्सैना	सदस्य
डॉ० मुकेश सक्सैना	सदस्य
श्री ए० जयरमन	सदस्य

प्रयोगशाला सुरक्षा समिति

डॉ० वैंकट राव सिस्ता	अध्यक्ष
प्रशासन अधिकारी	संयोजक
श्री सतीश कुमार खन्ना	सदस्य
श्री मोहन लाल सागू	सदस्य
डॉ० अशोक कुमार	सदस्य
श्री सुशील कुमार जैन	सदस्य
श्री विनय कुमार वर्मा	सदस्य

औषधालय समिति

श्री जगमोहन नागपाल	अध्यक्ष
सुश्री बृज मोहिनी सहगल	संयोजक
डॉ० मोतिया शैरोन	सदस्य
डॉ० महेन्द्र पाल	सदस्य
श्री बिपिन कुमार पुरी	सदस्य
प्रशासन नियंत्रक	सदस्य

आवास गृह आबंटन समिति

श्री माधबा नन्द बंदूनी	अध्यक्ष
अनुभाग अधिकारी (सा०)	संयोजक
श्री अरूण कुमार सिंह	सदस्य
श्री चन्द्र राज श्रीवास्तव	सदस्य
श्री राजेन्द्र सिंह	सदस्य

वाहन अग्रिम समिति

श्री बलदेव राज चड्ढ़ा	अध्यक्ष
अनुभाग अधिकारी (सा०)	संयोजक
डॉ० आशा मसोहन	सदस्य
श्री विनोद कुमार	सदस्य
श्री सुमेर चन्द्र	सदस्य

आई०आई०पी० स्टाफ कैन्टीन समिति

श्री हरीश कुमार मदान	अध्यक्ष
श्री हरबंस सिंह	सचिव
डॉ० आशा मसोहन	सदस्य
श्री विजय छिब्बर	सदस्य
श्री गोपाल प्रसाद शर्मा	सदस्य
श्री बिरेन्द्र काण्डपाल	सदस्य
डॉ० अशोक कुमार	सदस्य

आई०आई०पी० शिकायत निवारण समिति

डॉ० प्रदीप कुमार	अध्यक्ष
श्री योगेन्द्र कुमार	नामित सदस्य
डॉ० श्रीनाथ शर्मा	निर्वाचित सदस्य
श्री कृष्ण दत्त शर्मा	निर्वाचित सदस्य
श्री तुलसी राम	निर्वाचित सदस्य
श्री ध्यान सिंह	निर्वाचित सदस्य
श्री बिशम्भर दयाल वशिष्ट	संयोजक
प्रशासन नियंत्रक	पदेन सदस्य
वित्त एवं लेखा अधिकारी	पदेन सदस्य

DISTINGUISHED VISITORS

1.	Dr S Varadarajan, Chairman, Consultancy Development Centre, DSIR, New Delhi	April 25, 1990
2.	Mr L Kumar, Former Secretary, Min. of PRNG	October 18, 1990
3.	Dr SKO Seyfullaev, Russian Scientist	October 20-23, 1990
4.	Dr G Kapustin, Russian Scientist	November 20-23, 1990
5.	Dr Devendra Lal, Geological Research Division, Scripps Institute of Oceanography, University of California, San Diego	December 15-19, 1990
6.	Dr S C Gray, Research Manager, Chemical Coordination Group, Unilever, London	January 10, 1991
7.	Prof M T Rahman University of Dhaka	January 15, 1991
8.	Dr B W Wojciechowski Professor Chemical Engineering, Queens University, Canada	February 1, 1991
9.	Dr Sigmond Csisery UNIDO Consultant	February 12-13, 1991
10.	Prof S C Bhattacharyya, Honorary Visiting Professor, IIT Bombay	March 5-7, 1991
11.	Prof R I O Zavialov Russian Scientist	March 26-27, 1991

Sponsored Projects Completed During 1990-91

(Value Rs. in lakh)

1. Consultancy work pertaining to lab equipment for gas processing plant of GAIL at Vijaypur	GAIL	0.90
2. Evaluation of fuel economy additive RM-200	PCRA	0.40
3. Performance evaluation of engine oils	LIL, IOC(R&D)	14.50
4. Mass emissions measurement of two diesel engines	Escorts	0.24
5. Analysis of wax samples	AOD, IOC	0.234
6. Mass emissions evaluation of Maruti Gypsy	Maruti Udyog	0.50
7. Evaluation of Corrosion inhibitor RAAJ-225	IOC R&P	1.50
8. Feasibility study of paraffin wax production	CHT	5.85
9. Characteristics of imported paraffin wax samples	CHT	0.60
10. Measurement of mass emission of Maruti Gypsy Phase I & II	Maruti Udyog	2.35
11. Characterisation of Heavy Alkylate Bottoms	LIL	3.00
12. Evaluation of offshore Godavari crudes (RAVVA 10 and RAVVA 17)	ONGC	5.00
13. Wax manufacture at Barauni	IOC	1.50
14. Extraction of aromatics from reformate with TEG	EIL	1.07
15. Evaluation of additives	PCRA	0.65
16. Performance evaluation of 2T oil	LIL	0.32
	Total	38.614

PUBLICATIONS/PATENTS

Papers Published in Journals

Author(s)	Title
1. D K Adhikari, V S Saini, V R Sista, N M Surana and N Subrahmanyam	The mechanism of hydrocarbon uptake and solid hydrocarbon fermentation Indian Chemical Engineer, 32(2), 72-76, 1990
2. K M Agarwal, H U Khan, M Surianarayanan and G C Joshi	Wax deposition of Bombay High crude oil under flowing conditions Fuel, 69, 794-796, 1990
3. K M Agrawal, H U Khan, M Surianarayanan and G C Joshi	Role of flow improvers on the wax deposition of Bombay high crude oil during pipeline flow Hydrocarbon Technology, No. 13, 52-61, 1990
4. K M Agrawal, M M Mungali, G C Joshi and R Krishna	Studies on paraffin sediments of Bombay High crude oil. Erdoel und Kohle- Erdgas-Petrochemie, 43(10), 391, 1990
5. K M Agrawal and G C Joshi	Structural investigations on waxes derived from sucker rod wax scrappings. Erdoel und Kohle-Erdgas-Petrochemie, 43, 239, 1990
6. K M Agrawal, R C Ghildiyal and Y Kumar	Use of solvent leaching technique for deoiling of microcrystalline wax Research and Industry, 35, 177, 1990
7. R P Badoni and A Jayaraman	Polarographic analysis of conjugated diolefins in petroleum products J Electrochem Soc India 39(1) 47, 1990
8. R P Badoni and A Jayaraman	Determination of water content in organic compounds by gas chromatography using back flush technique. J Anal Chem, 338, 745-748, 1990
9. J S Bahl, U C Gupta and Himmat Singh	Paving grade bitumens from low asphaltene short residues Erdoel und Kohle-Erdgas-Pertochemie, 43(2) 438-442, 1991

Author(s)	Title
10. S D Bhagat	Gas chromatographic method to monitor the synthesis of N-methylpyrrolidone. Indian Journal of Technology 28, 71-74, 1990
11. V K Bhatia, V B Kapoor and S K Chopra	Analysis of naphtha fractions from hydro-cracked biocrude by gas chromatography The Analyst, 115(3), 253-257, 1990
12. V K Bhatia, A Chaudhary, G A Sivasankaran, R P S Bisht and Meenu Kashyap	Modification of Jojoba oil for lubricant formulations J Am Oil Chem Soc, 67(1), 1-7, 1990
13. G S Dang and B S Rawat	Solvent deasphalting - a review J Sci Ind Res, 49, 184-189, 1990
14. T C S M Gupta, A N Goswami and B S Rawat	Mass transfer studies in liquid membrane hydrocarbon separation J Membr Sci, 54, 184-189, 1990
15. H U Khan, K M Agrawal, M Surianarayanan and G C Joshi	Restartability and flow characteristics of Bombay High crude oil using model pipeline Oil and Gas-European Magazine, No. 1, 41-43 (1990)
16. H U Khan, M M Mungali, K M Agrawal and G C Joshi	Graphical method simplifies diesel cloud point determinations Oil and Gas Journal, 98-101 (September 24, 1990)
17. H U Khan, J Handoo, K M Agrawal and G C Joshi	Determination of wax separation temperature of crude oils from their viscosity behaviour Erdol und Erdgas-Kohle, 107(1), 21-22, 1991
18. G N Kulsrestha and M P Saxena	Coker distillates as source of linear alpha olefins and paraffins - Indian scenario Erdol und Kohle-Erdgas-Petrochemie, 43(10), 373-414, 1990
19. G N Kulsrestha, Uma Shanker, J P S Sharma and Jaswinder Singh	One step oxidation of cyclohexane to adipic acid J Chem Technol Biotechnol, 50, 57-65, 1991
20. Manjeet Singh, V S Saini, D K Adhikari, J D Desai and V R Sista	Production of bioemulsifiers by a SCP-producing strain of candida tropicalis during hydrocarbon fermentation Biotechnology Letters, 12(10), 743-746, 1990

Author(s)	Title
21. A Masohan, S M Nanoti, K G Sharma, S N Puri, P Gupta and B S Rawat	LLE studies on hydrocarbon (C_{10}-C_{20}) sulpholane systems Fluid Phase Equilibria, 61, 89-98, 1990
22. M M Mungali, K M Agrawal and G C Joshi	Influence of n-paraffins on the cold flow properties and response to cold flow improver in gas oil of Bombay High crude Hydrocarbon Technology No. 16, 119-128, 1991
23. J M Nagpal, S C Vishnoi, R L Sharma, V B Kapoor and R Krishna	Normal paraffins for linear alkyl benzene manufactured from Indian crudes Hydrocarbon Technology, No. 12, 53-59 (1990)
24. P C Nautiyal and J A Schey	Transfer of aluminium to steel in sliding contact : effect of lubricant J of Tribology, ASME Transaction, 112(2), 282-289, 1990
25. P C Nautiyal	Friction and metal transfer in sliding aluminium against iron implanted steel Surface Engg Ec SA Meguid, Canada, Elsevier Applied Science Publication, 146-155, 1990
26. B P Pundir	Vehicle emission control technology Indian and Eastern Engineer, Indian Automotive Annual 1990
27. R C Purohit, K M Agrawal and G C Joshi	Role of n-alkane components on the flow properties of vacuum gas oil fraction of Bombay High crude oil Erdol Erdgas-Kohle, 106, 36-38, 1990
28. R C Purihit, P S Verma, S P Srevastava and G C Joshi	Vacuum distillate and its fractions from Bombay High Crude Structural Investigation Erdol und Kohle-Erdgas Petrochemie. 44(2), 75-76, 1991
29. V Ramaswamy, M P Kapoor, V Kothiyal and I D Singh	Preparative method for chromatographic separation of olefinic hydrocarbons in cracked middle distillates Indian Journal of Technology, 28, 543, 1990

Author(s)	Title
30. B Rajeshwar Rao and S D Bhagat	Evaluation of solute-solvent interactions on some non-electrolytes with N-methylpyrrolidone by gas liquid partition chromatography Indian Journal of Chemistry, 29A, 652-655, 1990
31. B S Rawat, M K Khanna, B Kumar and R K Kuchhal	Removal of sulpholane from raffinate feed stock Indian Journal of Technology, 29(3), 142-144, 1991
32. S L S Sarowha	Composition of deasphalted oils of petroleum residues Indian Journal of Technology, 28, 183-186, 1990
33. I D Singh, V Ramaswamy, V Kothiyal, D Severin and U Kollmeir	Compositional differences in supercritical fluid extract and short path distillates of petroleum short residue Fuel Sci Technol Int 8, 467, 1990
34. I D Singh, V Kothiyal and V Ramaswamy	Visbreaking reactions of short residues : compositional and structural studies Erdol und Kohle-Erdgas- Petrochemie. 44, 22, 1991
35. I D Singh, M P Kapoor and V Ramaswamy	Storage stability of visbroken residual fuel oil Fuel, 70, 195, 1991
36. H Singh, G S Chaudhary, K Kishore and R S Kaushik	Refining of propane deasphalted stock with N-methylpyrrolidone and phenol Indian Journal of Technology, 28, 177-182, 1990
37. Himmat Singh	Needle coke - a technological study Erdol und Kohle-Erdgas-Petrochemie, 44(2), 67-70, 1991
38. H Singh and I B Gulati	Tribological behaviour of some hydrocarbon compounds and their blends Wear, 139, 425-437, 1990
39. S K Singhal, P S Mehta and B P Pundir	Modelling spray/wall interaction in swirling flows for DI diesel engines Proceedings Int Mech Engg (London), 1990

Author(s)	Title
40. S P Srivastava, K M Agrawal, S V K Dilawar, P S Verma, R S Tandon and G C Joshi	Wax crystallization and gel formation in Bombay High crude oil Erdol und Kohle-Erdgas-Petrochemie, 44(1), 26-28, 1991
41. V G Stepanov, R P Dabral, V V Chesnokov, G V Yechevsky, E A Paukshit and K G Ione	Time on stream investigation of the selectivity of the process of hydrocarbon aromatisation over HZSM-5 catalysts Proceedings of the 10th National Symposium on Catalysis and 4th Indo-Soviet Seminar on Catalysis, December 18-21, 1990 Edited by B Viswanathan and C N Pillai in Recent Developments in Catalysis Theory and Practice 1991, pp 422-430.
42. Uma Shanker, D S Rawat, R P Dabral and K K Bhattacharyya	Kinetics of vapour phase disproportionation of toluene over H-mordenite Erdol und Kohle-Erdgas-Petrochemie, 43, 12, 1990
43. Uma Shanker and G N Kulsrestha	Kinetics of auto-oxidation of sec-butyl toluene Erdol und Kohle-Erdgas Petrochemie, 44(3), 121-122, 1991

Papers Presented in Seminars/Workshops/Conferences

1. V K Bhatia	Liquid fuel from biomass : an overview Seminar on application and Management of Energy in Agriculture : The Role of Biomass Fuels, IIT, Delhi May 21-23, 1990
2. R S Gaharwar, A K Bhatnagar M P Saxena, V K Bhatia and G C Joshi	Oleochemicals as lubricants and additives Symposium on R&D Perspectives in Oils and Fats, IICT, Hyderabad, May 30, 1990
3. B P Pundir and Sudhakar Das	Status of vehicular air pollution in India and control technology National Symposium on Automobile Pollution Monitoring - Its Effects and Control, Bombay, June 7-8, 1990

Author(s)	Title
4. V S Saini, V R Sista, N M Surana and N Subrahmanyam	Studies on microbial dewaxing of petroleum fractions Indian Chemical Engineering Congress 1990, BHU Varanasi, December 18-21, 1990
5. D K Adhikari, V S Saini V R Sista and N Subrahmanyam	Role of dimensionless groups on microbial dewaxing ibid.
6. B P Pundir	Vehicle air pollution and control system National Conference on standardisation in Automobile Section, Jamshedpur, January 3-4, 1991
7. B Kumar, R B Gupta, H C Chandola and Pradeep Kumar	Characterisation of heavy alkylated bottoms by G C - Mass technique Fifth National Symposium on Mass Spectrometry, PRL, Ahmedabad, January 7-9, 1991
8. K M Agrawal and G C Joshi	Properties and composition of hard microcrystalline waxes from some North Gujarat crude oil tank sludges 7th LAWPSP Symposium, IIT, Bombay, January 19-21, 1991
9. M M Mungali, K M Agrawal, and G C Joshi	Response of cold flow improvers in commercial Indian diesel fuels ibid
10. B R Chadha, S K Chhibber, K S Anand and M S Ratra	Disposal of acid sludge during white oil preparation ibid
11. R S Tandon, S P Srivastava, K M Agrawal, P S Verma and G C Joshi	Precise determination of wax appearance and gel formation temperature by optical microscopy ibid
12. O N Anand, Vijay Kumar, V P Malik, R P S Bisht	The reactivity of alkyl aryl sulphides with iron surface and their load carrying characteristics ibid

Author(s)	Title
13. S Patil and Himmat Singh	Catalytic/hydro dewaxing for lubes-An appraisal. ibid.
14. S K Singhal and K K Gandhi	Strategies for use of non conventional energy sources in the transport sector Seminar on Potential of Development of Non-conventional Energy Technologies in the Armed Forces, Pune, January 22-23, 1991

Patents Filed

1. A N Goswami, A Sharma and B S Rawat	A continuous three phase fluidized bed process for demulsifying oil-in-water emulsions (App No. 932/DEL/90 - 21.9.90)
2. A K Gupta and Rameshwar Prasad	A process for the preparation of alkyl benzene (App No. 867/DEL/90 - 30.8.90)
3. J S Bahl, Himmat Singh, Umesh Gupta and Deepak Tandon	An improved process for the preparation of FDA grade microcrystalline waxes (App No. 1175/DEL/90 - 27.11.90)

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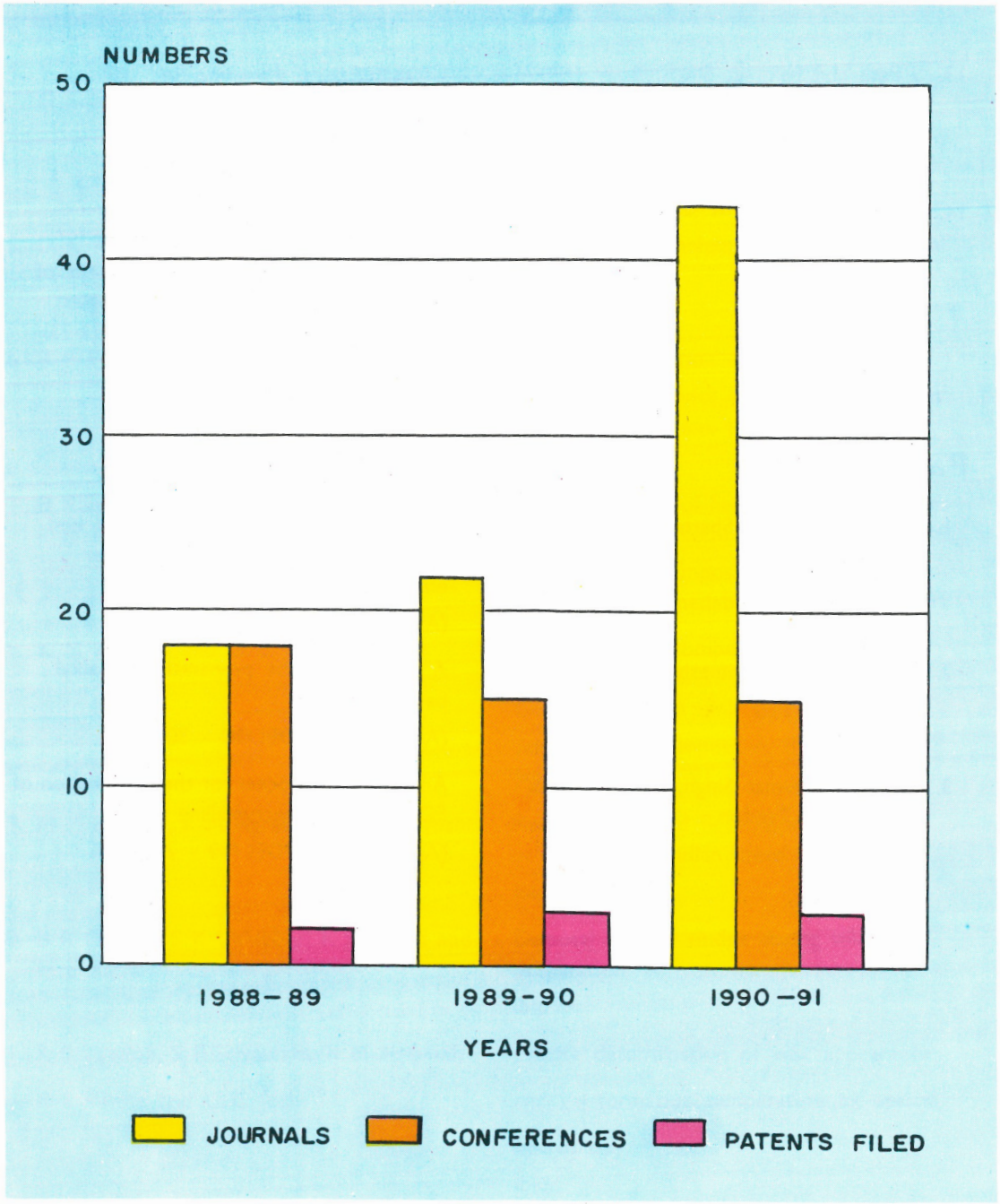

COLLOQUIA ORGANISED

	Speaker	Title	Date
1.	Ms Archana	Jojoba Oil : A source of specialty chemicals	March 22, 1990
2.	Mr John E Wetherall UOP, U.K.	Petroleum and related activities of UOP	March 22, 1990
3.	Professor R V Gopalarao University of Jadavpur Jadavpur	Statistical mechanics of micro-molecules and emulsions	April 11, 1990
4.	Dr G Kapustin Scientist, N.D. Zelinsky Institute of Organic Chemistry USSR	Measurement of acidity of catalysts by absorption calorimetric method and its comparison with other techniques of determination, correlation of acidity with catalytic activity.	November 21, 1990
5.	Mr S C Gray UNILEVER, UK	Chemical business of UNILEVER and R&D	January 10, 1991
6.	Professor M T Rahman Dhaka University	Magnesium based cuprates in organic synthesis	January 16, 1991
7.	Professor B W Wojciechowski Queens University Ontario, Canada	Effect of gas oil composition on cracking	February 1, 1991
8.	Professor Sigmond Csicsery UNIDO Consultant	Shape selective catalysts in zeolite and how to test and how not to test catalysts	February 11 & 13, 1991
9.	Professor S C Bhattacharyya Honorary Visiting Professor IIT, Bombay	Naturally occurring musks-an interesing group of compounds, and Essential oils, fragrance and flavours	March 5 & 7, 1991
10.	Mr J M Nagpal Scientist, IIP	Conversion of natural gas to liquid hydrocarbons	March 11, 1991

अधिकारीगण (31.3.91 तिथानुसार)

वैज्ञानिक एवं तकनीकी अधिकारी

निदेशक

डॉ० टी एस आर प्रसाद राव

कार्यक्षेत्र समन्वयक

श्री सुधर सिंघल
डॉ० गिरीश चन्द्र जोशी
श्री जी बालमल्लया

कच्चा तेल एवं उत्पाद मानांकन प्रभाग

श्री सुरेश चन्द्र विश्नोई	**वैज्ञानिक ई ।**
श्री ए जयारमन	**वैज्ञानिक ई ।**
श्री जगमोहन नागपाल	**वैज्ञानिक ई ।**
श्री श्याम सुन्दर लाल गर्ग	इंजीनियर सी
डॉ० श्रीनाथ शर्मा	**वैज्ञानिक सी**
डॉ० लालजी दीक्षित	**वैज्ञानिक सी**
श्री ओम प्रकाश गुप्ता	**वैज्ञानिक सी**
श्री सिलाश फ्रैंकलिन फिश	**वैज्ञानिक सी**
श्री रामलुभाया शर्मा	वैज्ञानिक सी
श्री विद्याभूषण कपूर	वैज्ञानिक सी
श्री हरि शरण माथुर	तकनीकी अधिकारी सी
सुश्री स्नेह किरण चोपड़ा	तकनीकी अधिकारी बी
श्री कल्याण दत्त नीमला	वैज्ञानिक बी
श्री गुलाब सिंह भंडारी	वैज्ञानिक बी
श्री योगेन्द्र कुमार शर्मा	वैज्ञानिक बी
श्री यादराम	वैज्ञानिक बी
श्री गजेन्द्र भूषण तिवारी	वैज्ञानिक बी

पृथक्करण प्रक्रम प्रभाग

डॉ० बचन सिंह रावत	वैज्ञानिक ई ॥
डॉ० मोहन लाल सागू	वैज्ञानिक ई ॥
श्री जोगेन्द्र शाह बहल	वैज्ञानिक ई ।
श्री मोहम्मद अनवर	वैज्ञानिक ई ।
श्री गुरबख्श सिंह डंग	इंजीनियर ई ।
श्री गिरिजा शंकर चौधरी	वैज्ञानिक ई ।
श्री उमेश चन्द्र अग्रवाल	वैज्ञानिक सी

श्री सोमनाथ पुरी	वैज्ञानिक सी
श्री कौशल किशोर	वैज्ञानिक सी
श्री श्रीकृष्ण	इंजीनियर सी
डॉ० मोहन कृष्ण खन्ना	वैज्ञानिक सी
श्री नरेन्द्र नारायण कुलश्रेष्ठ	वैज्ञानिक सी
डॉ० (सुश्री) आशा मसोहन	वैज्ञानिक सी
डॉ० अमर नाथ गोस्वामी	वैज्ञानिक सी
डॉ० सतीश कुमार शर्मा	वैज्ञानिक बी
श्री श्रीकांत मधुसूदन नानोटी	वैज्ञानिक बी
श्री नीरज अथैया	वैज्ञानिक बी
श्री राधेश्याम कौशिक	तकनीकी अधिकारी बी

रूपांतरण प्रक्रम प्रभाग

श्री मोहन लाल	वैज्ञानिक ई II
श्री गिरीन्द्र नारायण कुलश्रेष्ठ	वैज्ञानिक ई II
श्री रघुनाथ प्रसाद मेहरोत्रा	वैज्ञानिक ई II
श्री कृष्ण गोपाल मित्तल	वैज्ञानिक ई II
डॉ शिवदत्त भगत	वैज्ञानिक ई II
डॉ० प्रभात कुमार पाण्डेय	वैज्ञानिक ई II
श्री वीरेन्द्र कुमार कपूर	वैज्ञानिक ई II
डॉ० प्रदीप कुमार	वैज्ञानिक ई II
डॉ० जोगेन्द्र सिंह बावा	वैज्ञानिक ई I
डॉ० कृष्ण माधव शरण	वैज्ञानिक ई I
डॉ० उमा शंकर	वैज्ञानिक ई I
श्री प्रकाश चन्द्र गुप्ता	वैज्ञानिक ई I
डॉ० इन्द्र देव सिंह	वैज्ञानिक ई I
श्री मनमोहन कुमार	वैज्ञानिक ई I
डॉ० योगेश कुमार कुच्छल	वैज्ञानिक ई I
श्री दयाल सिंह रावत	वैज्ञानिक ई I
डॉ० बृज बहादुर अग्रवाल	वैज्ञानिक ई I
श्री जय राम राय	वैज्ञानिक ई I
श्री निर्माल्य रे	वैज्ञानिक सी
श्री बृज मोहन लाल वढेरा	इंजीनियर सी
डॉ० हरि भगवाल गोयल	वैज्ञानिक सी
श्री रामेश्वर प्रसाद	वैज्ञानिक सी
डॉ० रिझवानी मूलचन्द्रा	वैज्ञानिक सी
श्री गुरचरण सिंह सरना	वैज्ञानिक सी
श्री राजेन्द्र प्रसाद बड़ोनी	वैज्ञानिक सी
डॉ० एल० डी० शर्मा	वैज्ञानिक सी

श्री प्रेम विजय डोगरा	वैज्ञानिक सी
डॉ० राम बहादुर गुप्ता	वैज्ञानिक सी
श्री रामेश्वर प्रसाद डबराल	वैज्ञानिक सी
श्री बसन्त कुमार	वैज्ञानिक सी
श्री उमेश चन्द्र गुप्ता	वैज्ञानिक सी
डॉ० आलोक कुमार सक्सैना	वैज्ञानिक सी
श्री हेम चन्द्र चन्दोला	वैज्ञानिक सी
श्री रवीन्द्र कुमार अग्रवाल	वैज्ञानिक बी
श्री एस० एम० धीर	वैज्ञानिक बी
श्री दीपक टण्डन	वैज्ञानिक बी
डॉ० सुखलाल सिंह सरोहा	वैज्ञानिक बी
डॉ० गौतम दास	वैज्ञानिक बी
डॉ० जे० के० गुप्ता	वैज्ञानिक बी
श्री शमशाद अहमद कुरैशी	वैज्ञानिक बी
श्री माधव उपाध्याय	वैज्ञानिक बी
श्री श्रीचन्द्र गुप्ता	वैज्ञानिक बी
श्री गोविन्द प्रसाद शर्मा	तकनीकी अधिकारी ए

कार्बनिक रसायन प्रभाग

डॉ० गिरीश चन्द्र जोशी	वैज्ञानिक एफ
डॉ० वीरेन्द्र कुमार भाटिया	वैज्ञानिक ई ॥
डॉ० अशोक कुमार गुप्ता	इंजीनियर ई ॥
डॉ० दिनेश चन्द्र	वैज्ञानिक ई ।
डॉ० कृष्ण मोहन अग्रवाल	वैज्ञानिक ई ।
डॉ० महेन्द्र प्रताप सक्सैना	वैज्ञानिक ई ।
श्री रघुवीर सिंह गहरवार	वैज्ञानिक ई ।
डॉ० पप्पू सत्यनारायण मूर्ति	वैज्ञानिक ई ।
डॉ० अजय कुमार भटनागर	वैज्ञानिक सी
डॉ० सुरेश चन्द्र जोशी	वैज्ञानिक सी
डॉ० शान्ति प्रकाश श्रीवास्तव	वैज्ञानिक सी
डॉ० रमेश चन्द्र पुरोहित	वैज्ञानिक सी
डॉ० हयात उल्लाह खान	वैज्ञानिक सी
डॉ० आलोक कुमार चटर्जी	वैज्ञानिक सी
श्री प्रेम किशोर शर्मा	वैज्ञानिक सी
श्री कृष्ण कुमार	वैज्ञानिक सी
श्री पवन कुमार गोयल	वैज्ञानिक बी
श्री जयपाल सिंह शर्मा	इंजीनियर बी
डॉ० बृज मोहन लाल भाटिया	वैज्ञानिक बी
श्री सुरेन्द्र विजय कुमार दिलावर	तकनीकी अधिकारी ए

पेट्रोलियम उत्पाद अनुप्रयोग प्रभाग

श्री सुधीर सिंघल	इंजीनियर एफ
डॉ० बुध प्रकाश पुण्डीर	इंजीनियर ई II
डॉ० प्रकाश चन्द्र नौटियाल	इंजीनियर ई II
श्री कंचन कूमार गांधी	इंजीनियर ई II
श्री सुशील कुमार जैन	इंजीनियर ई II
श्री वेद प्रकाश मलिक	वैज्ञानिक ई I
श्री विजय कुमार जैन	इंजीनियर ई I
श्री बलदेव राज चड्ढा	वैज्ञानिक ई I
श्री रवि कुमार शर्मा	इंजीनियर ई I
डॉ० गिरीश चन्द्र मिश्रा	वैज्ञानिक ई I
डॉ० वी० आर० के० शास्त्री	इंजीनियर ई I
श्री ओंकार नाथ आनन्द	वैज्ञानिक ई I
श्री रोशन लाल मेन्दीरत्ता	इंजीनियर ई I
डॉ० मुकेश सक्सैना	इंजीनियर ई I
श्री प्रमोद खानवलकर	तकनीकी अधिकारी ई
डॉ० मैथ्यू अब्राहम	इंजीनियर ई I
श्री माधबानन्द बंदूनी	तकनीकी अधिकारी सी
श्री त्रिभुवन चन्द्र जोशी	तकनीकी अधिकारी सी
श्री वेद प्रकाश चावला	इंजीनियर सी
डॉ० सतीश कुमार गोयल	वैज्ञानिक सी
श्री दिनेश कुमार	इंजीनियर सी
श्री बाल मुकुन्द शुक्ला	इंजीनियर सी
श्री मांगे राम त्यागी	इंजीनियर सी
श्री जनार्दन शर्मा	इंजीनियर सी
श्री अनिल केशव आयगल	इंजीनियर सी
श्री सुमेश कुमार छिब्बर	वैज्ञानिक सी
श्री सतीश कुमार सिंघल	वैज्ञानिक सी
श्री प्रेम बल्लभ सेमवाल	वैज्ञानिक सी
डॉ० महेन्द्र पाल	वैज्ञानिक सी
श्री अमर कुमार जैन	इंजीनियर सी
श्री आशीश कुमार गोन्दल	इंजीनियर सी
श्री सुधाकर दास	इंजीनियर सी
श्री मुकेश गुप्ता	इंजीनियर सी
श्री सोमनाथ भट्टाचार्जी	इंजीनियर सी
श्री नवल किशोर पाण्डे	वैज्ञानिक सी
डॉ० दया शंकर शुक्ला	वैज्ञानिक सी
श्री सागर माजी	इंजीनियर सी
डॉ० राजपाल सिंह बिष्ट	वैज्ञानिक सी

श्री पुरूषोत्तम दास	तकनीकी अधिकारी बी
श्री लाजपत राय गुप्ता	तकनीकी अधिकारी बी
श्री हरबंस सिंह सेवक	तकनीकी अधिकारी बी
श्री राजेश कुमार सिंह	वैज्ञानिक बी
श्री बलबीर सिंह जसवाल	तकनीकी अधिकारी ए
श्री हीरा बल्लभ कोठारी	तकनीकी अधिकारी ए
श्री चन्द्र बल्लभ नौटियाल	तकनीकी अधिकारी ए

औद्योगिक एवं घरेलू दहन प्रभाग

श्री प्रेम नाथ भम्बी	इंजीनियर ई II
श्री त्रिलोक नारायण सिंह	इंजीनियर ई II
श्री हरीश कुमार मदान	इंजीनियर ई I
श्री कृपाल सिंह कम्बो	वैज्ञानिक ई I
श्री कृष्ण मुरारी अग्रवाल	वैज्ञानिक सी
श्री कुलदीप नारायण डोभाल	वैज्ञानिक सी
श्री सतीश कुमार खन्ना	वैज्ञानिक बी
श्री उमेश कुमार जयसवाल	इंजीनियर बी
श्री अबनाशी लाल अरोड़ा	तकनीकी अधिकारी बी

इंजीनियरी सेवा प्रभाग

श्री प्रेमनाथ भम्बी	इंजीनियर ई II
श्री दर्शन लाल कपूर	तकनीकी अधिकारी ई II
श्री रविन्द्र नाथ राय	इंजीनियर ई I
श्री गुरचरण सिंह	तकनीकी अधिकारी सी
श्री स्टैनली पोरशन	तकनीकी अधिकारी सी
श्री विनय कुमार वर्मा	इंजीनियर सी
श्री निशान सिंह	इंजीनियर सी
श्री पी० एन० भास्कर	तकनीकी अधिकारी सी
श्री रणजीत कुमार बनर्जी	तकनीकी अधिकारी बी
श्री हरि राज शरण शर्मा	सहायक कार्यपालक इंजीनियर
श्री प्रदुमन सिंह फुल	तकनीकी अधिकारी बी
श्री नरेश रंजन गुप्ता	तकनीकी अधिकारी बी
श्री जसबीर सिंह	तकनीकी अधिकारी बी
श्री सुधांशु गुप्ता	तकनीकी अधिकारी बी
श्री हंस राज अग्रवाल	तकनीकी अधिकारी बी
सुश्री पूनम गुप्ता	वैज्ञानिक बी
श्री राम लुभाया घई	तकनीकी अधिकारी ए
श्री सुरेश चन्द्र गुप्ता	तकनीकी अधिकारी ए
श्री सत्य प्रकाश डोभाल	तकनीकी अधिकारी ए

श्री सत्य प्रकाश शर्मा	तकनीकी अधिकारी ए
श्री ए० डी० छाबड़ा	तकनीकी अधिकारी ए
श्री एम० एन० शर्मा	तकनीकी अधिकारी ए
श्री जय कृष्णा कुमार	तकनीकी अधिकारी ए
श्री गुलाब चन्द्र गुप्ता	तकनीकी अधिकारी ए
श्री राम अवतार गर्ग	तकनीकी अधिकारी ए

पेट्रोलियम बायोटैक्नोलॉजी

श्री वेंकट राव सिस्ता	वैज्ञानिक ई ॥
श्री वीरेन्द्र सिंह सैनी	वैज्ञांनिक सी
श्री दिलीप कुमार अधिकारी	वैज्ञानिक सी

प्रोजेक्ट ग्रुप

श्री योगेन्द्र कुमार	वैज्ञानिक ई ॥
श्री एस० के० जैन	वैज्ञानिक ई ।
श्री ए० वी० गोमकले	वैज्ञानिक सी

प्रशिक्षण प्रभाग

डॉ० हिम्मत सिंह	वैज्ञानिक ई ॥
श्री विनोद प्रकाश शर्मा	इंजीनियर सी

औद्योगिक सम्पर्क

डॉ० कृष्ण स्वरूप जौहरी	वैज्ञानिक ई ॥
श्री चन्द्र मोहन खन्ना	फोटो अधिकारी सी
श्री मोहन लाल	वैज्ञानिक सी
श्री सुबोध कुमार बन्सल	सूचना अधिकारी सी
श्री जयदेव अहलूवालिया	तकनीकी अधिकारी सी
श्री प्रमोद कुमार जैन	इंजीनियर सी
श्री आनन्द कुमार अग्रवाल	वैज्ञानिक बी
श्री सतेन्द्र कुमार मल्होत्रा	तकनीकी अधिकारी बी
श्री गुणा नन्द मधवाल	फोटो अधिकारी बी
श्री गोविन्द बल्लभ	प्रलेख अधिकारी बी
श्री ऋषि कुमार चावला	वैज्ञानिक ए

पुस्तकालय

श्री रमेश चन्द्र जोशी	सूचना अधिकारी सी
श्री दीन दयाल शर्मा	पुस्तकालय अधिकारी बी

राजभाषा अधिकारी

श्री हनुमन्त लाल	प्रशासन नियंत्रक

प्रशासन

श्री हनुमन्त लाल	प्रशासन नियंत्रक
श्री खुर्शीद अहमद कुरेशी	वरिष्ठ भंडार एवं क्रय अधिकारी
श्री महेन्द्र पाल सिंहल	प्रशासन अधिकारी
श्री भरत सिंह रावत	वित्त एवं लेखा अधिकारी
श्री सत्य प्रकाश कोठारी	निजी सचिव/अनुभाग अधिकारी
श्री आनन्द प्रकाश भाटिया	वरिष्ठ निजी सहायक
डॉ० (सुश्री) मोतिया शेरोन	आवासीय चिकित्सा अधिकारी
डॉ० अशोक कुमार	आवासीय चिकित्सा अधिकारी
श्री नरेन्द्र सिंह रमोला	सुरक्षा अधिकारी
श्री चन्द्र नारायण भार्गव	तकनीकी अधिकारी बी
श्री मिल्खी राम भगत	अनुभाग अधिकारी
श्री निरंजन सिंह वर्मा	अनुभाग अधिकारी
श्री सत्य पाल सिंह	भंडार एवं क्रय अधिकारी
श्री बिशम्भर दयाल वशिष्ठ	अनुभाग अधिकारी
सुश्री सुशीला सिंघल	वरिष्ठ निजी सहायक

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