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PREFACE

This report highlights the research work carried out at the NCL from April 1985 to March 1986. While in the sixties and early seventies short-term projects of immediate industrial relevance accounted for the major share of NCL's research efforts, in the late seventies these efforts were largely reoriented towards long-range projects of social and industrial significance. This, however, has not resulted in short-term projects being pushed to the rear or in weakening links between the laboratory and the industry. On the contrary, these have become stronger as evident from the large number of sponsored and collaborative research projects being undertaken on behalf of user industries at the NCL.

Research at the NCL is made up of three well-defined components : short-range projects, long-range projects, and the basic research associated with the overall programme of the laboratory. During the period under review research at the NCL has been carried out in 10 areas. In each area NCL has been striving to maintain a high degree of excellence, using sophisticated tools and methods to achieve the R&D goals in keeping with the current approach to research adopted the world over, and in doing so the established pattern of interdisciplinary approach has remained the cornerstone of NCL's activities with equal emphasis on long-range and short-range projects.

A brief account of the R&D activities during the period is given below.

Research and development activities

An integrated pilot plant, consisting of an ethylene generation unit and a high pressure oxidation reactor with gas recycle, was commissioned for testing the NCL catalyst for the vapour phase oxidation of ethylene to ethylene oxide. The process conditions for the dehydration of ethanol to ethylene on the Encilite catalyst and for the purification of ethylene were optimized.

The Encilite-1 catalyst was charged in the Indian Petrochemicals Corpn. Ltd.'s 45,000 TPA xylene isomerizer and has been running exceptionally well. Encilite-1 has proved to be superior to the conventional catalysts used earlier. The importance and international significance of the successful use of Encilite-1 in IPCL has been recognized through the Forward Development Technology Award by the Indian Chemical Manufacturers Association to IPCL for the year 1985. In this award NCL has been recognized individually through appropriate citations.

A novel process for the manufacture of ethylbenzene using Encilite-2 was developed. The catalyst underwent successful plant trials and was found to be economically attractive — it can save up to Rs. 1000 per ton of ethylbenzene.

4-Dimethoxy-daunomycin, a synthetic analogue, is 8-10 times more effective than the anti-tumour drugs, adriamycin and daunomycin. Its total synthesis by the coupling of 4-demethoxy daunomycinone and L-daunosamine derivative. Two more elegant routes were worked out for the synthesis of ($\pm$) 4-demethoxydaunomycinone.

Fredericamycin A, an anti-tumour antibiotic produced by *Streptomyces griseus,* possesses an entirely novel spiro nonane system. A simple model system representing this spiro molecule was built and its conversion into the spiro system was studied.

Work was also carried out on a host of vitamins, antibiotics, and drugs and intermediates to combat tumours, leukemia, tuberculosis, peptic ulcers, arthritis, diarrhoea, hypertension and malaria. A considerable amout of work was also carried out on insect hormones and pheromones, growth regulators and synthetic dyes.

In the field of biotechnology work was undertaken to obtain improved rice and pigeon pea plants through gene manipulation. Computer programs were developed for deriving parsimonious molecular evolutionary trees. Measures were developed to identify a unique solution from a set of most-parsimonious solutions.

Studies were continued towards developing the ability to prescribe preparation conditions for amorphous silicon based materials in thin film form with the desired characteristics for solar photovoltaic applications.

Two synthetic routes were developed for making ($\pm$) *cis*-DV acid, an important intermediate in the synthesis of the highly potent photostable pyrethroid alphamethrin. Work was also undertaken to standardise a three-step laboratory scale process for DV acid.

Microencapsulation of carbofuran in urea resin condensates was studies in detail and a procedure for studying the release kinetics of these products under stirred conditions in water was worked out.

In the NABARD-sponsored project — budwood was collected from many elite trees of *E. tereticornis, E. camaldulonisis* and *Salvadora persica.* Cultures were established from some of them. Cultures were also isolated from seedlings of bamboo raised from seeds obtained from different states. These cultures are now at the multiplication stage.

The data obtained in this project is being computerized. As part of the programme of work in this project, a short term workshop was conducted on, Application of Tissue Culture to Forestry for the representatives of the participating agencies.

Various studies were carried out for the genetic modification of plants through protoplast technology.

A process for the synthesis of polyphenylene sulphide (PPS) has already been demonstrated on laboratory scale. Now, jointly with Shri Ram Fibres,

Madras, the process is being scaled up and guidelines are being developed for processing the polymer. Efforts are also being made to develop a laboratory scale process for moulding grade PPS powder.

Designs for a semi-commercial plant for producing sulphochlorinated polyethylene (SCPE) were submitted to Shriram Rayons on the basis of which Davy Powergas (India) are setting up a plant at Kota. Work was started on a new grade of SCPE with far superior properties.

A great amount of work was carried out for developing a drag reducing polymer for the pipeline transport of crude oil. Development of a pour-point depressant for the North Gujarat crude forms part of the project.

In the studies to obtain polymers from renewable resources hard rubber was obtained from transesterified castor and soft rubber from difunctional castor oil. Rubbers with high strength, hardness and good elongation were obtained from isocyanate terminated prepolymers of polyesters.

Work on engineering plastics has led to the standardisation of a process to give polyphenylene oxide (PPO) of the required molecular weight and another to prepare a PPO blend with polystyrene for one of the basic grades. Some work was also carried out on polymers that can prove useful for electronic applications.

Under basic research work of a high order was carried out on photochemical reactions, amino acids and peptides, low molecular weight xylanase, polymer modification and characterisation, chemical reaction in solid reforms and studies on UV stable polymers for solar applications.

Patents and publications

14 new patents were filed during the year. 80 Indian patents (21 sealed, 4 accepted and 55 filed) and 19 foreign patents were in force as on 31-3-86. 288 research papers were published. 42 staff members, research fellows and guest-workers received post-graduate degrees (7 M.Sc. and 35 Ph.D.). 55 NCL scientists are recognised as research guides by different universities.

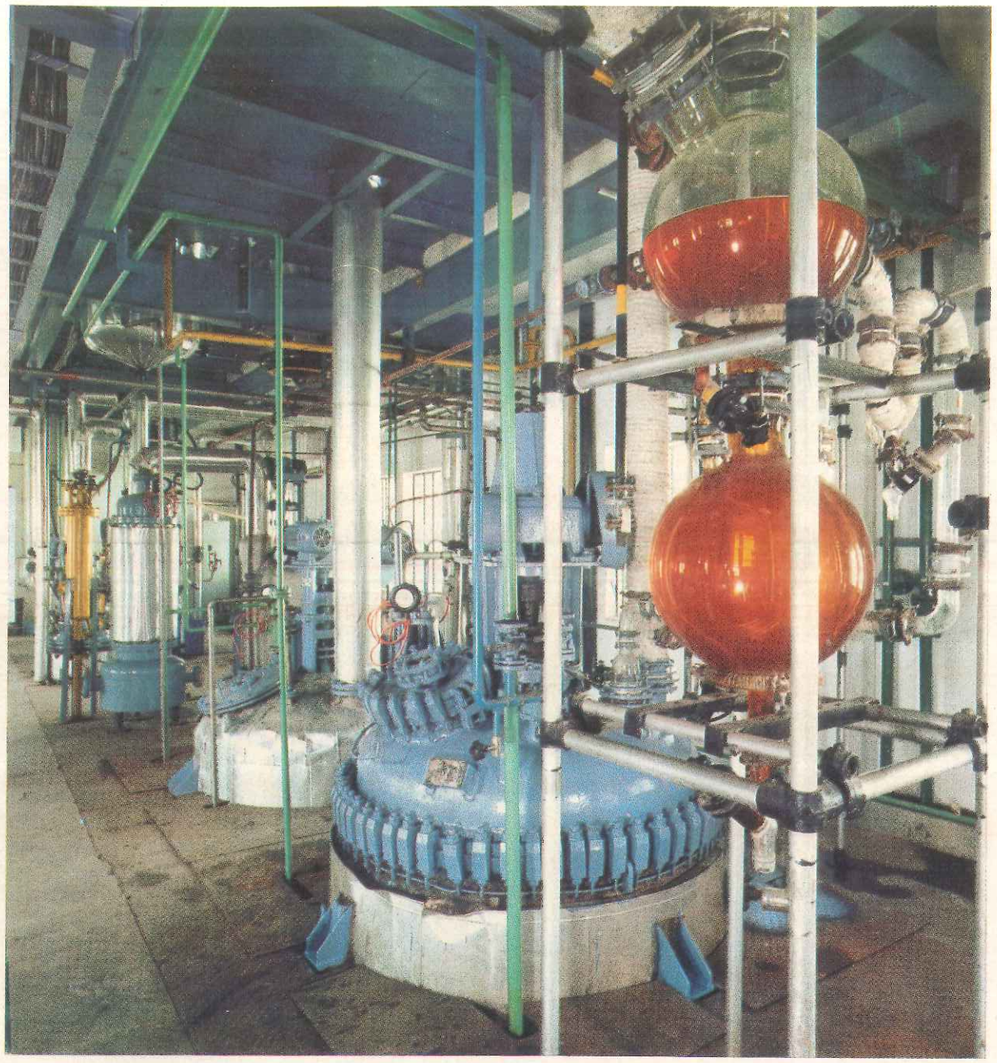
Research Utilization.

During 1985-86, 60 NCL processes were in production with a turnover of Rs. 52.52 crores. The foreign exchange saving on account of production during this period is estimated of about Rs. 21.01 crores.

December, 1987
NCL, Pune

(L.K. Doraiswamy)
Director

1. Xylene isomerization plant of IPCL, Vadodara, Capacity 50,000 TPA



2. Vitamin B_6 plant of Lupin Laboratories Pvt. Ltd., Bombay (Factory at - Ankleshwar), Capacity 50 TPA

1 CATALYSIS AND CATALYTIC REACTION ENGINEERING

1.1 Vapour phase oxidation of ethylene to ethylene oxide (1-1-467 C)

The integrated pilot plant, consisting of an ethylene generation unit (capacity : 3 kg ethylene per hour) and a high pressure (20 atm) oxidation reactor (capacity : 0.7 kg ethylene oxide per hour) with gas recycle, was commisioned for testing the NCL catalyst and developing a process for the oxidation of ethylene to ethylene oxide. The process conditions for the dehydration of ethanol to ethylene on the Encilite catalyst and for the purification of ethylene have been optimized. Pilot plant testing of the oxidation catalyst under commercial process conditions is in progress.

The effective diffusivity of ethylene, carbon dioxide and oxygen in the porous catalyst support has been measured under reaction conditions by gas chromatographic method based on moment analysis. The studies on catalyst characterization, chemisorption of oxygen and adsorption of reaction species on the catalyst under reaction conditions are in progress.

1.2 Applications of homogeneous catalysis and C_1 chemistry.

1.2.1 Acetic acid/acetic anhydride via carbonylation of methanol (1-10-267)

Novel homogeneous catalysts have been developed for carbonylation of methanol to acetic acid and acetic anhydride. These catalysts are cheaper and have many advantages over the conventional catalysts. A collaboration plan with Davy McKee, UK, for developing a process for the conversion of methanol to acetic acid is being considered.

1.2.2. Oxo alcohols

A catalyst for low pressure hydroformylation of olefins has been developed, which has important applications in the manufacture of oxo alcohols for use in detergents.

1.2.3. Methyl ethyl ketone (MEK)

A catalyst for selective conversion of n-butenes to methyl ethyl ketone (MEK) has been developed. The process based on this catalyst can also be used for simultaneous separation of isobutene. This project has been sponsored by National Organic Chemical Industries Ltd., Thane.

1.3. Catalytic reactions over synthetic zeolites

The aim is to synthesize known and new zeolites with commercial application. Besides well-known applications novel applications have also been investigated. The aim has also been to study catalytic processes using known/new zeolite formulations for industrial use. In keeping with the current research aimed at a better understanding of zeolite catalysis has also been carried out.

1.3.1. Zeolite synthesis
Alumino phosphates

Laboratory synthesis of a number of recently discovered alumino and silico-alumino phosphate zeolites has been achieved so far. Some variants of these zeolites containing atoms other than silicon and aluminium in the lattice positions have also been synthesized.

1.3.2. Catalyst development for petroleum refining and petrochemical industries and for coal conversion processes

(i) Xylene isomerization (1-6-467)

The Encilite-I (NCL Zeolite) catalyst was charged in the Indian Petrochemicals Corpn. Ltd. (IPCL), Baroda 45,000 TPA xylene isomerizer and has been running exceptionally well. Encilite-I has proved to be superior to the conventional catalysts used earlier. Based on this trial IPCL is likely to use Encilite-I in their expansion of isomerizer capacity to 90,000 TPA within the next two years. The importance and international significane of the successful use of Encilite-I in IPCL has been recognised through the Forward Development Technology award by the Indian Chemical Manufacturer's Association (ICMA) to IPCL for the year 1985. In this award NCL has been recognised individually through appropriate citations. NCL has been awarded a certificate in recognition of its ''Successful penetration into this hightech area''. NCL is now in a position to offer complete technology package for the isomerisation of xylenes in collaboration with IPCL, Baroda and Engineers India Ltd. (EIL), New Delhi. This technology package has been named 'Xylofining'.

(ii) Fluid catalytic cracking (FCC) catalyst (1-26-267)

NCL has established facilities for physico-chemical evaluation and micro-catalytic activity testing of the catalyst in the area of FCC catalysts. In collaboration with Indian Oil Corporatioon Research and Development Centre, Faridabad, NCL has undertaken a major programme on development of indigenous FCC catalysts which could be used to produce maximum middle distillates from different crudes normally processed in India.

(iii) Hydroprocessing catalyst (1-30-247)

Development of catalyst for hydroprocessing/hydrodewaxing of waxy distillates from petroleum feed stocks using NCL Encilite catalysts. This work has been undertaken in association with United Catalysts India Ltd., (UCIL), Bombay. The catalyst has been developed and tested on a laboratory scale with promising results. More work on the catalyst and process development are in progress in collaboration with UCIL.

(iv) Manufacture of ethylbenzene (EB) (1-32-467)

A novel process for the manufacture of ethylbenzene using NCL zeolite catalyst designated Encilite-2 has been developed. The catalyst has undergone successful plant trials in India and found to be economically attractive. A party in India is planning to modify their present ethylbenzene plant to employ NCL's process based on Encilite-2. NCL's process/catalyst will lead to a saving of Rs. 1000 per ton of EB manufactured by the above company.

(v) Catalyst for reforming of naphtha

NCL has also developed a catalyst for reforming of naphtha. Initial formulations of catalysts using Encilite prepared are being tested at IPCL, Baroda.

(vi) Coal conversion catalysts

(a) Methanol to light olefins

A catalyst/process for conversion of coal or industrial gas derived methanol to light olefins has been developed under joint agreement with Davy McKee, U.K. The pilot plant for testing the catalyst is being designed by Davy McKee.

(b) Production of middle distillates (1-29-246)

India's requirement of petroleum products in the middle distillates range is not likely to be met from indigenously produced crude petroleum for a long time to come. On the other hand India has large reserves of natural gas, which is being used at present for fuel purposes. Converting the natural gas/methane to middle distillates could be one answer to India's chronic shortage of kerosene and diesel. The middle distillate fraction obtained from Bombay High is of poor quality rich in aromatics. The middle distillates made from methanol obtained from natural gas will be of super quality and could be used as a blending stock to improve the quality of the Bombay High distillates fraction. Laboratory scale testing of the catalyst developed at NCL is promising. Further work is in progress to optimise the catalyst formulations and process conditions to achieve the maximum selectivity for middle distillates.

1.4 Synthesis and structural characterisation of novel complexes especially carbonyls (1-19-024)

Several novel carbonyl complexes of ruthenium (II) and rhodium (I) with bidentate and tridentate chelating ligands containing potential hydroxyl or thiol group have been synthesized and studied. The bonding scheme for these chelates have been established using spectroscopic data. Stable binuclear hexacoordinated ruthenium (II) derivatives have been prepared using flexibly bridging dithio bis (β-diketone) ligands. The S-S bond in these complexes has been found to be extremely stable towards nucleophilic reagents. Substitution of carbonyl ligands in the binuclear rhodium (I) complexes $(Rh(CO_2))_2L$ using monodentate sigma or pi donor molecules have been studied. A weaker sigma donor like organic phosphites replaced both the carbonyl ligands whereas triphenyl phosphine could replace only one carbonyl owing to steric reasons. 2-Mercapto-, 5-thioalkyl-, 1, 3, 4, thiadiazole ligands form octahedral ruthenium (II) complexes having exceptionally short bite angles. The unusual stability of these complexes is attributed to the increased affinity of ruthenium atom to sulphur.

A heterogeneous catalyst comprising silica and tungsten (in the complex form) has been synthesized and patented for the oligomerization of lower olefins to middle distillates. The same cataylst has been found suitable for the oligomerization of C_6-C_8 olefins present in the lower boiling fraction of hydrocarbons obtained in the fluid catalytic, cracking (FCC) process in refineries. Synthetic, high performance kerosene and diesel have been obtained out of these oligomers. This catalyst has a long life and can be regenerated by the usual techniques.

1.5 Development of improved catalyst for oxidation of toluene to benzaldehyde (I-25-467 sp)

The aim is to improve the performance of the catalyst developed earlier in this laboratory or develop a new catalyst with a higher selectivity for benzaldehyde. A catalyst testing unit has been set up for this purpose and catalyst development work is in progress.

1.6 Basic studies

(i) Kinetics of hydrogenation of o-nitrophenol on palladium carbon (Pd-C) catalyst has been studied and a Hougen-Watson rate model for the catalytic process has been proposed.The influence of various mass transfer processes and solvent on the hydrogenation rate was also investigated. The solubility of hydrogen in methanol containing the reaction species for the hydrogenation has been determined under reaction conditions. The adsorption of the reaction species on the (Pd-C) catalyst has been studied under the reaction conditions. Poisoning of the catalyst by sulphur, chloro- and heavy metal compounds in the hydrogenation process has been investigated.

ii) The time on stream activity of alkali-metal (Li,Na,K) doped MgO and pure MgO catalysts in the partial oxidation of methane to C_2-hydrocarbons has been investigated as also the influence of alkali-metal concentration in alkali-metal doped MgO on its performance in the oxidative methane conversion process. Na-Mgo showed the highest catalyst stability and selectivity for C_2 -hydrocarbons.

iii) Crystalline molecular sieve $AlPO_4$-5 has been synthesized in the form of Pr_3N-$AlPO_4$-5 and the crystallization and morphological changes during the crystallization of $AlPO_4$-5 from the gel at 150° have been investigated.

Thermal decomposition of Pr_3N-$AlPO_4$-5 for removing the occluded template from the aluminophosphate has been investigated by TG, DTG and DTA in inert and oxidizing atmosphere. The site energy distribution of $AlPO_4$-5 and its catalytic activity in cracking of hydrocarbons viz. cumene, n-hexane, iso-octane, and butyl benzene isomers, isomerization of o-xylene, disproportionation of toluene and the conversion of methanol and ethanol to aromatics, as a function of pulse number have been investigated.

Influence of thermal, hydrothermal and acid/base treatments on the structural stability and surface and catalytic properties of $AlPO_4$-5 has also been thoroughly investigated.

Heat of sorption of n-hexane, benzene and cyclohexane (at near zero sorbate concentration) on $AlPO_4$-5 has been determined by the gas chromatographic (GC) pulse technique. Sorption isotherms of benezene, n-hexane, cyclohexane and pyridine at 200-400° have been measured using the GC pulse technique based on the peak maxima method and thermodynamic data for the sorption evaluated. Sorption capacity of the aluminophosphate for water, alcohols and various hydrocarbons at the relative pressure of 0.4 has also been determined.

iv) The influence of intercrystalline mass transfer on the catalytic activity and product distribution in the o-xylene isomerization, iso-octane cracking and methanol-to-aromatics conversion reactions on the ENCILITE-I has been investigated. The effective intercrystalline diffusivity of the zeolite catalyst under reaction conditions has been measured by studying the iso-octane cracking reactions in the catalyst of different particle sizes. The influence of catalyst particle size on both the catalytic activity and product distribution in the above reactions has been observed to be strong.

v) Effect of degree of cation exchange and calcination temperature of H.Na-ZSM-8 on its acid strength distribution and catalytic properties in the isomerization of o-xylene and m-xylene, disproportionation of toluene and methanol-to-aromatics conversion reactions has been investigated.

vi) A gas chromatographic method for studying the shape selective behaviour of narrow pore zeolites has been developed and employed for investigating the shape selectivity in the sorption of hydrocarbons in silicalite and ZSM-8 zeolites.

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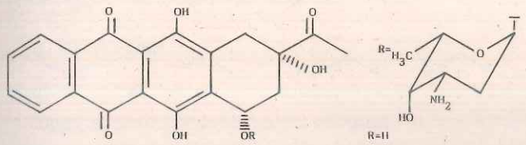
2. DRUGS AND DRUG INTERMEDIATES

2.1 Synthesis of anticancer agents

2.1.1 Synthesis of 4-demethoxydaunomycinone

In the earlier reports, the total synthesis of anthracylinones such as daunomycinone, 4-demethoxydaunomycinone 11-deoxydaunomycinone, 4-demothoxy-11-deoxydaunomycinone and the aminosugar, L-daunosamine starting from D-glucose and D-glucosamine were reported.

4-Demethoxy-daunomycin, a synthetic analogue is 8-10 times more effective than adriamycin and daunomycin as antitumor drug, and its total synthesis by the coupling of 4-demethoxydaunomycinone and L-daunosamine derivative has now been achieved.

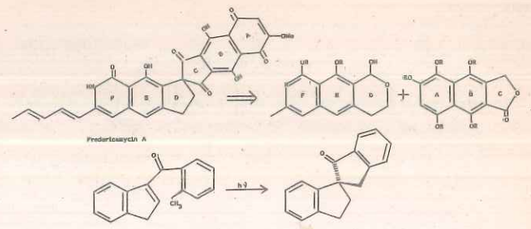


Recently, two more elegant routes to the synthesis of (±) 4-demethoxydaunomycinone were worked out. Marschalk reaction of leucoquinizarin with levulinic (oxo-ketal) aldhyde gave 2- (4-oxo-n-pentane)-quinizarin which on formulation followed by second Marschalk reaction led to (±)-4-demethoxy-7, 9-dideoxydaunomycinone, which were used for the synthesis of (±)-4-demethoxydaunomycinone. In an alternative approach, modified Marschalk reaction of leucoquinizarin with 4-bromo-2-aceto (ketal)-1-butyraldehyde gave 4-demethoxy-7, 9-dideoxydaunomycinone in one step. Simplicity and selectivity are characteristics of the synthetic procedures developed at NCL, which can also be suitably employed in technical preparations.

2.1.2 Fredericamycin A

Fredericamycin A, an antitumor antibiotic produced by ***Streptomyces griseus,*** possesses an entirely novel spiro (4,4) nonane system. A simple model system representing this spiro molecule has been built starting from 2-(2-hydroxyethyl)- phenylindan-1, 3-dione and its conversion into spiro system studied. Recently a novel photochemistry of π-π^* triplet of enone was applied to the synthesis of a model spiro compound related to fredericamycin A.

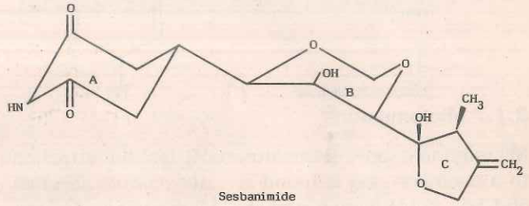
Our next concern was the construction of appropriately substituted benz. phthalide derivative (ABC-ring system) and isoquinoline derivative (DEF ring



system). The benz-phthalide derivative has been prepared by two different routes. Simultaneously, the isoquinoline derivative has also been prepared by three different methods. The condensation of these two units followed by further transformations would lead to the target molecule.

2.1.3 Synthesis of Sesbanimide

Sesbanimide, isolated from the seeds of *Sesbania* drummod and Sesbania punices has been found to be potent antitumor agent. The synthesis of AB-rings of sesbanimide has been carried out starting from D-sorbitol, D-glucose and D-xylose. Simultaneously the synthesis of C-ring of sesbanimide has been worked out.



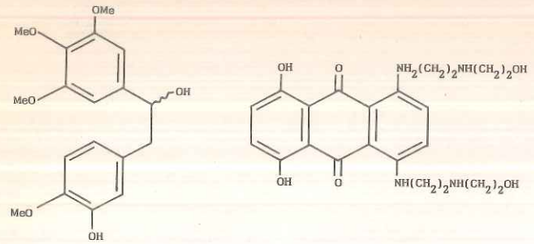
Sesbanimide

2.1.4 Synthesis of Combretastatin

Combretastatin, contained in the plant *Combretum caffrum,* possesses antineoplastic activity in the central nervous system. A simple synthesis of (+) combretastatin starting from isovanillin and 3,4,5-trimethoxybenzaldehyde has been achieved.

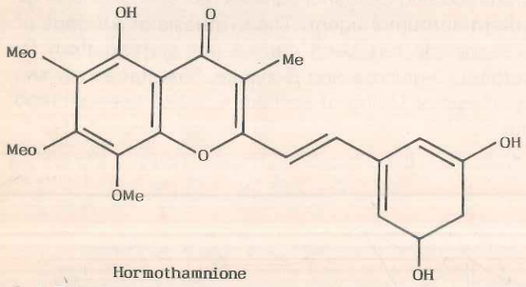
2.1.5. Mitoxantrone (Novantrone)

Mitoxantrone, a new synthetic anthraquinone derivative, has shown to have excellent antileukemic activity. The synthesis of mitoxantrone has been undertaken to develop a commercially viable method for its preparation.



2.1.6. Hormothamnione

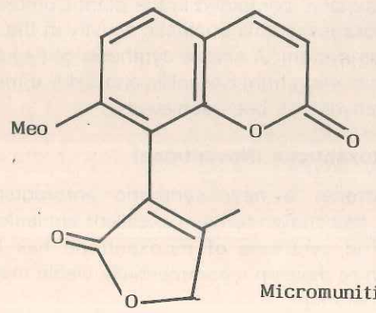
Hormothamnione, a novel cytotoxic styrylchromone is isolated from the marine cyanophyte *Hormothamnione entromorphoides.* It is an exceptionally potent cytotoxin to cancer cells *invitro* and appears to be a selective inhibitor of RNA synthesis. 2,6-Dihydroxy-3,4,5--trimethoxypropiphenone prepared from phloroglucinol was converted into 2,3-dimethyl-5-hydroxy-6,7,8--trimethoxychromone which on condensation with 3,5-dibenzyloxy-benzaldehyde gave the desired styryl chromone. Debenzylation of the styrylchromone is expected to lead to the formation of hormothamnione.



Hormothamnione

2.1.7 Micromunitin

Micromunitin, an∝-β-unsaturated ϑ-lactone attached to a coumarin ring is found in *Micromeium minutum* and has antileukemic activity. Methodology for the preparation of ∝-aryl-β-methyl-∝-β-unsaturated-ϑ-lactones has been established. Attempts are being made to synthesise micromunitin.



Micromunitin

2.2 Synthesis of drugs and drug intermediates

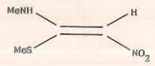
2.2.1 Pyrazinamide

It is one of the important anti-tubercular drugs and its use is increasing in the country. Earlier approaches for pyrazinamides were not commercially viable. A different and innovative process has been worked out. The work is in progress.

2.2.2 Ranitidine

Glaxo Laboratories introduced ranitidine in 1980. It is a new histamine H_2 - receptor antagonist, effective in the treatment of peptic ulcers. The aim of the R & D work was to develop a commercially viable and economic method for making it. The two intermediates, the diamine and the nitroethene required in the synthesis have been successfully prepared.

diamine



nitroethene

2.2.3 Diacerhein

Diacerhein (1,8-diacetoxy anthraquinone-3-carboxylic acid), currently available in Italy, is a new anti-arthritic drug, which does not inhibit prostaglandin synthesis. Its synthesis starting from 1,5-dihydroxynaphthalene has been initiated.

2.2.4 Loperamide hydrochloride

This is an antidiarrhoeal drug. Its demand is approx. 160 Kg. per annum and the requirement is met by import. An economic laboratory scale process using readily available raw materials has been worked out.

2.2.5 Codeine

An innovative process for the methylation of morphine to codeine using phenyltrimethyl ammonium chloride which acts both as a methylating agent and phase transfer catalyst has been developed. The process has been demonstrated successfully to Government Opium and Alkaloids Works at Neemuch (M.P.) and Ghazipur (U.P.)

2.2.6 Ethylmorphine

An innovative process for the ethylation of morphine to ethyl morphine using a phase transfer catalyst has been developed. The process has been adopted by Government Opium and Alkaloids Works at Ghazipur.

2.2.7 Clonidine (Antihypertensive drug)

An elegant, cost effective synthesis of clonidine, an important antihypertensive drug has been developed from readily available o-nitrochlorobenzene. In this synthesis *ortho*-chloro-phenylhydroxylamine obtained from o-nitrochlorobenzene is formylated to N-(2-chlorophenyl) -N-hydroxy formamide. The formamide is then converted to clonidine by chlorinating it first with thionyl chloride and then with thionyl chloride/sulfuryl chloride, and condensing the product with ethylenediamine.

2.2.8 3,4,5-Trimethoxybenzaldehyde

3,4,5-Trimethoxybenzaldehyde is an intermediate required for making the antibacterial drug, trimethoprim. Attempts are being made to develop a commercially viable process for the imtermediate starting from either phenol, *p*-cresol or gallic acid.

2.3 VITAMINS

2.3.1 Vitamin B_6

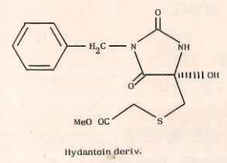
The process for vitamin B_6 starting form ethyl or methyl acetoacetate was successfully developed and released to Lupin Laboratories Private Limited, Bombay. After successful pilot plant runs a commercial plant was established and trial production commenced.

2.3.2 Vitamin E

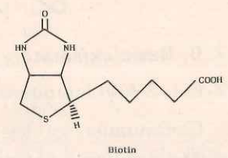
The aromatic portion of vitamin E, 2,3,5-trimethylhydroquinone, is prepared starting from p-xylene in the five steps. Condensation of phytol isomers obtained by Prins reaction on norphytene with 2,3,5-trimethylhydroquinone gives vitamin E in 80% yield. The process is being optimised.

2.3.3 Biotin

A novel synthesis of N^3-benzyl-5-carbomethoxy mercaptomethyl hydantoin, a potential chiral intermediate for (+) biotin has been achieved, starting from L(+) cysteine. Work on converting this into biotin is in progress. If successful, this should prove a commercially viable route.



Hydantoin deriv.



Biotin

2.4 β -Lactam antibiotics

2.4.1 7-ADCA

7-Aminodeacetoxylephalosporanic acid is a valuable intermediate for β - lactam antibiotics belonging to cephalosporin class, particularly cephalexin. Imports of cephalexin during 1984-85 amounted to 36 tones valued at Rs. 6 crores. A process for the preparation of 7-ADCA from penicillin G has been undertaken and encouraging results have been obtained.

2.4.2 Cloxacillin Sodium

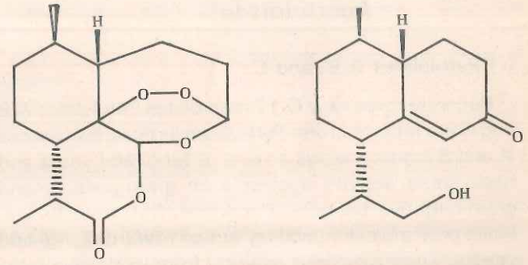
This is an important semisynthetic penicillin, and is largely imported either as the antibiotic or as its important intermediate, chlorophenylisoxazolymethyl carbonyl chloride (CIMCCL). The imprts during 1984-85 amounted to about 187 tonnes valued at Rs. 1.8 crores.

Work has been intiated on the development of an efficient process for the preparation of CIMCCL. A laboratory scale process has been completed.

2.5. Methodology in organic synthesis

2.5.1 Artemisinin

Artemisinin (quinghaosu) is an antimalarial active principle isolated from *Artemisia annua* (Qinghas in chinese). Two approaches have been envisaged for its synthesis. The first one involves the preparation of the key intermediate hydroxymethylethyl-10-methyl-4--oxobicyclo (4,4,0)-dec-5-ene. This has been achieved.



Artemisinin

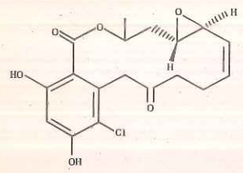
The second approach is for the total synthesis of artemesinin involving Diels Alder reactions, starting from either cyclopentenone (for dl-artemesinin) or from l-menthene (for natural antipode of artemesinin). The work is in progress.

2.5.2 Macrolides

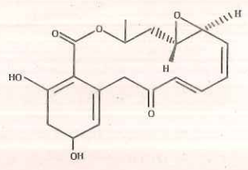
(a) Radicicol and monocillins I-V

Radicicol and monocilins I-V are structurally related

14-membered lactone ring macrolides possessing antifungal activity. These have been isolated from *Nectria radicicola* and *Monocillium nordinii* respectively. All of them consist of an aromatic moiety derived from orsellinic acid. The aliphatic synthons have been prepared starting from pent-l-yn-4-ol. Further work is in progress.



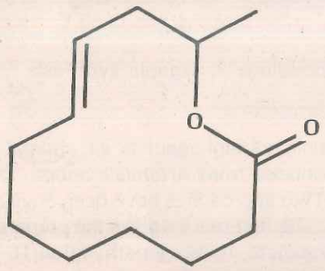
Radicicol



Monicillin-I

(b) Recifeiolide

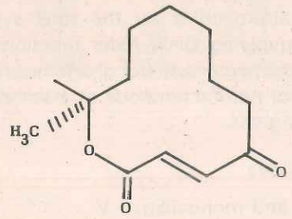
It is a naturally occurring 12 membered ring lactone isolated from *Ceohalosphorium recifei.* Its total synthesis starting from pent-l-yn-4-ol has been carried out.



Recifeiolide

(c) Patulolides A,B and C.

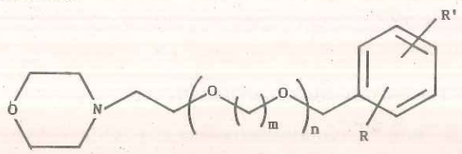
Recently three new C-12 macrolides Patulolides A,B and C are reported form *Penicillium urticae.* Patutolides A and B inhibit various strains of fungi and yeast and have some activity against both gram-positive and gram-negative bacteria. Patulolide 'C', however, exhibits only a weak inhibitory action towards fungi and yeasts. Their synthesis starting from lactic acid from a suitably substituted acetylene have been undertaken.

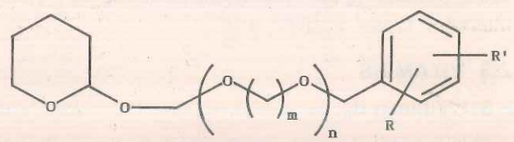


Patulolide A

2.5.3 Ionophores

Ionophores complex with different mono and divalent cations and assists in their transport through liquid and biological membranes. They thus play a major role in biological systems. Some simple synthetic compounds which mimic natural ionophores in their ionophoric properties have been prepared. They are being tested for their ion complexing and ion-transporting abilities.

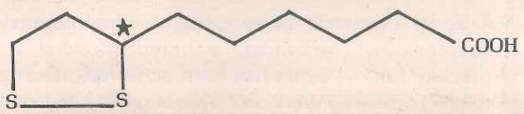




R = acid or ester; R' = CH_3

2.5.4 ∝-Lipoic acid

Lipoic acid is a growth factor for many bacteria and protozoa. It is used in the treatment of liver disorders. A short synthetic strategy has been developed for ∝-lipoic acid from 1,3-propane dithiol. A new synthesis of (S)-(-)- lipoic acid using l-menthone chiral template has been achieved. Similarly, d-menthone gives natural (R)-(+)-∝-lipoic acid. Similar studies on models indicated that use of (R)-(+)-camphor, (+)-isopinocaphane and 2-caranone should give natural (R)-(+)-∝-lipoic acid.



∝-Lipoic acid

2.6. Basic/exploratory studies

2.6.1 2-Aryl isatogens

Continuation of the work on o-aminophenyl or aralkyl ketones and their derivatives resulted in a new synthesis of 2-arylisatogens containing o or p-nitrogroups in the aryl moiety starting from o or p-substituted nitrotoluenes, trimorpholino methane and substituted o-nitrobenzoyl chlorides. Isatogens exhibit varied biological activity and are of current interest. The work is being carried out under collaboration with Sunderland Polytechnic, UK under a link programme.

2.6.2 Photochemical reactions in organic synthesis

The new photochemical methodology developed for cyclopentane annulation has been utilised in the synthesis of (±)-$\Delta^{9,10}$ capnellene, a marine product, known for its biological activity.The synthesis is from Δ^3-carene and involves a sequence of reactions including the photochemical reaction at a key step. The work is in progress.

A systematic study of photo-induced addition of hydroxyl radicals to terpenic olefins has been carried out. Interestingly enough, anti-Marknownikoff addition has been observed as a major process leading to secondary alcohols.

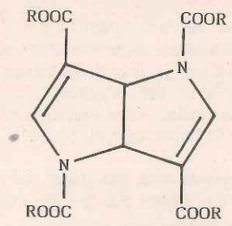
2.6.3 Studies in analysis

EI and CI MS of acetylated anomeric glycosides and IR and NMR of metal diethyldithiocarbonates have been studied.

A simple and accurate Carius combustion method for microdetermination of Cl/Br in organic compounds containing noble metals has been developed, which was further extended for P estimation of palladium by AA spectrometry.

2.6.4 Organic azides

Our continued efforts in the investigation of the reactions of nitrene intermediates generated from organic azides have resulted in the synthesis of novel heterocycles such as diazabicyclooctadienes, azepines and substituted oxazolidinones which are being screened for their biological activity. The insertion reaction $^1\Delta$ state of NH radicals in C-H bonds are significant from the point of view of the understanding the basic proceses leading to the origin of life.



Diazabicyclooctadiene

2.6.5 Synthetic dyes

The reaction of l-aminoanthraquinone and 1,5-diaminoanthraquinone with ∝, β -unsaturated carbonyl compounds such as acrylonitrile, methyl acrylate, methyl methacrylate and diethylethoxymethylene malonate yielded new substituted dihydroanthrapyridinequinones. The compounds were evaluated as disperse dyes on polyester.

The colour-chemical constitution aspects of several 3-substituted 2-aryl phenalen-l-ones and the dyes such as CI disperse Red 303 which incorporate the phenalene-l-one as the basic chromophore have been studied using their UV-visible spectra. The fluorescene spectral data of CI Disperse Red 303 consisting of two components (1 and 2) revealed that component 1 is more fluorescent than component 2, although 2 is more bathochromic as compared to 1. The difference in the fluroscene intensity has been explained on the basis of difference in polarity of the carbonyl group brought about by the positional difference of the ring sulphur atom, an electron donor. Final confirmation of these observations was obtained by the x-ray crystallographic study of component 1 of CI disperse Red 303.

A potential industrial outlet for *o*-cumidine, an intermediate for new monoazo and disazo solvent dyes is reported. New solvent dyes prepared from *o*-cumidine had much better solubilities than the corresponding dyes derived drom *o*-toluidine. Absorption maxima of the *o*-cumidine based dyes were generally comparable with those of analogaue *o*-toluidine derivatives. The performance of 4-*o*-cumidine as a fast base was comparable with that of fast Garnet BGBC Base.

2.6.6 Natural colouring matter.

(a) *Pterocarpus santalinus* Linn (Red Sanders)

Preliminary work on the above plant has shown that it contains, besides other substances, a mixture of colouring matter to the extent of almost 10%. This is one of the rich sources of a naturally occurring colouring matter. The total extract possesses anti-inflammatory properties as well.

(b) *Cedrus deodar* Loud

A new compound, a keto diol has been isolated from ***Cedrus deodar*** Loud. Its structure by spectral data and further chemical correlation has been elucidated.

2.6.7 Amino acids and Peptidis

Synthesis of two tetra peptides, BOC-Cys (Bzl)-Pro-Leu-Gly-OMe and BOC-Cys (Bzl)-Pro-Leu-D-Phg-OMe,

related to enkaphalin sequences was carried out. The spectral studies on these peptides and their intermediate di and tri peptides were carried out. Further x-ray structure studies are in progress.

A reagent, Bis morpholino phosphonic chloride for the synthesis of peptides was investigated. The reagent was found to be useful for hindered amino acids. A few dipeptides were synthesised.

The dipeptide sweetner, aspartame, was synthesised from formyl aspartic anhydride and methyl ester of phenylalanine.

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3. BIOTECHNOLOGY

3.1 Fermentation of molasses to ethanol UNDP (4.1.167) (i,ii,iii)

Investigations were continued in the following areas:

1) Improvement of the physical strength of calcium alginate beads
2) Study of growth and conversion efficiency of *S.uvarum* using molasses in continuous cultures
3) Improvement of cell concentration in broth and conversion efficiency using instrumented lab fermenters.

3.2 Molecular biology and genetic engineering (4-5-001)

3.2.1 Improved rice and pigeon pea plants through gene manipulation

Rice and pigeon pea seed storage proteins were first fractionated into different components. Rice 60 KD albumin and 18 KD glutelin were further purified to homogeneity. In case of pigeon pea, legumin and vicilin proteins, the components of glubulins, were also purified. Antibodies were raised against each of these proteins in New Zealand white rabbit and these were characterised using different immunological techniques such as RIA, ELISA, and Western blotting. High molecular weight genomic DNA from rice and pigeon peas was isolated and conditions for its partial digestion to yield 18-23 kb fragments were standardized. The two vector DNAs namely charon 35 (for genomic library construction) and gt 11 (for cDNA library construction) were prepared and characterized.

3.2.2 Molecular geneology : a computer-based approach

No given macromolecule, whether it is a resource pool for biotechnology or it has a specific role in the metabolism of living organisms can be viewed in isolation. There is always a nearest neighbour whose performance index may be as good, better or worse. This neighbourliness extends back over evolutionary time. The kin recognition and kinship relationships are important facets of evolutionary biology and a necessary adjunct for identifying resource pools for biotechnology. Kinship relationships are also important for meaningful gene transfers since compatability between the donor and the host is vital to any studies in recombinant DNA technology.

We have an active group working in this area of basic research. During 1986, we have developed computer programs for deriving parsimonious molecular evolutionary trees. We have also developed measures to identify a unique solution from a set of most parsimonius solutions. Using this novel approach we are currently discerning kinship relationships and tempo and mode of evolution of prokaryotes and protists. We believe that this approach would help us measure precisely the evolutionary rates of macromolecules during descent from their most common ancestor.

3.3 Separation technology (4-6-001)

3.3.1 A new uranyl nitrate catalyst was developed for photo polymerisation of polyacrylamide gel at acid pH. In contrast to the ammonium persulphate catalyst, this catalyst is required in very small amounts.

3.3.2. Structure and function of biomolecules

i) Xylanases

Low molecular weight xylanase was purified to homogeneity by the final two steps-DEAE factose column chromatography and Sephadex gel filtration.

ii) Glucose xylose isomerases

Extracellular specific xylose isomerase was purified to homegeneity. In addition, a specific extracellular glucose isomerase was also identified in the culture filtrates of *chainia*. The same organism also possesses an intracellular non-specific glucose (xylose) isomerase. Purification of this enzyme to homogeneity was also carried out.

iii) Single crystal X-ray diffractional studies on low molecular weight xylanase

High activity alkaline proteinase, from *conidiobolus sp.* Out of the two enzyme isomers, the one in larger proportion (70%) was purified to homogeneity and detailed studies on its properties were carried out. The enzyme activity was stabilized by concentration and addition of stabilizers. Applications of the enzyme was shown for (a) Resolution of DL isomers of N acetyl DL phenylaniline methyl ester and N acetyl DL phenylglycine methyl ester (b) In animal cell culture for cell dissociation. (c) Preparation of protein hydrolysates from soya bean and casein.

3.4 High fructose corn syrup (4-8-167 Sp)

1) Preliminary work on the standardization of different estimation methods were completed as under:

i. Benedict's method for total reducing sugar estimation;
ii. glucose determination with glucose oxidase, peroxidase and o-dianisidine;
iii. fructose estimation by cysteine-carbazole method;
iv. total solids (Sugars) by refractometer;
v. glucose and fructose assay by rotation.

2. Process data was collected for the conversion of glucose to fructose with imported immobilized enzyme and subsequent separation.

A quick method for *in situ* detection of glucose isomerase and xylose isomerase by polyacrylamide gel electrophoresis was developed which was useful in the purification of the enzyme from *Streptomyces.*

Different strains from various genera viz. *Actinoplanes, Arthrobacter* and *Streptomyces* were collected. Their revival and subculturing was carried out for screening of glucose isomerase activity.

The production of glucose isomerase from the NCL isolate *(Streptomyces sp)* was studied and fermentation conditions on a 10 liter scale were optimized for high enzyme productivity. Work is in progress on evaluation of 16 polymers for immobilization of the enzyme and studying the characteristics of the immobilized enzyme.

3.5 Basic Studies

3.5.1 Identification of germ plasm resource pools for biotechnology

Low molecular weight xylanase from the actinomycete *Chainia* (NCL82-5-1) has been investigated. A joint collaborative programme with Iowa State University, USA and International Paper Inc.,USA has been proposed and is about to be finalised.

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4.1. Amorphous silicon thin films for photovoltaic applications (7-2-004(11)

More recently it has been shown that short range order (SRO) in hydrogenated amorphous tetrahedral semiconductor materials (e.g., a-Si, a-Ge, a-Si_x-Ge_{1-x}) has a significant effect on their optical band gap, density of states in the forbidden gap, and electronic properties. A systematic study of the correlations between SRO and preparation parameters on one hand and between the structural order and electronic properties on the other hand have therefore been undertaken at NCL. This has been aimed at developing our ability to prescribe preparation conditions for the amorphous silicon based materials in thin film form with desired characteristics relevant to solar photovoltaic applications.

For evaluation of SRO in the amorphous tetrahedral semiconductor, Raman Scattering (RS) has proved to be an important and only sensitive technique. In amorphous Si and Ge, the translational symmetry is lost due to the absence of long range order (LRO). Eventually this lifts the requirement of translational symmetry invariance for the wave-vector rendering all the phonon modes first order Raman allowed. The scattering amplitude in this first order Raman Spectrum for strokes scattering is related to the phonon density of states ρ (w) through the approximate relation.

$$I(w) \sim [(n+1)/w]\ (\rho(w).\ C(w)$$

Where C (w) is assumed to be a smoothly varying electron-phonon coupling constant, and n is the Bose-Einstien factor. Since the tetrahedral SRO is preserved in a-Ge and a-Si, ρ (w) becomes simply broadened version of that of their crystalline counterparts. The SRO, defined in terms of (i) the tetrahedral bond angle variations, (ii) dihedral angle variations, (iii) variations in ring-statistics, has been observed theoretically to have a pronounced effect ρ (w). Hence RS becomes a powerful technique to study the structural disorder in the amorphous a-Si and a-Ge like materials.

In this period the nature of columnar growth and short range order in a-Si:H films has been studied as a function of thickness using Raman Scattering. The films have been prepared by glow-discharge dissociation of silane diluted in argon and using high rf powers. The TO-bandwidth in the Raman Spectra has been used as a measure of the order in the amorphous phase. Thicker films deposited using 20% or more of silane yielded Raman spectra similar to those of hydrogen rich amorphous silicon alloys. Raman spectra of thinner films were similar in structure to those of rf sputter deposited pure a-Si films. Films grown under identical conditions exhibit thickness dependent improvement in the short range order in amorphous phase. The TO-bandwidth decreases rapidly with increasing thickness and then becomes constant at a threshold thickness, t_s. With decreasing silane concentration(σ), the ts value is first found to decrease, reaches a minimum at 7% and then abruptly increases near (σ)=3.5%. These results are explained in terms of variation of compressive stress in the film as a function of silane dilution.

4.1.1 Transparent conducting oxides

Pure and Sb-doped SnO_2 films have been deposited by two different techniques:metal-organic chemical vapour deposition (MO-CVD), and spray pyrolysis of $SnCl_4$ in presence of air with different concentrations of Sb. X-ray and UV photoelectron spectroscopic studies have been carried out on these films and the combined XPS and UPS data provided information about the electronic properties of Sb-doped SnO_2 films and their compositions. Contrary to expectations, binding energy of SnO is higher than that of SnO_2 and this is due to the fact that SnO_2 is more covalent than SnO. XPS is sucessfully used to confirm the presence of Sb^{+3} and Sb^{+5} beyond a concentration 0.5 mole % of Sb in the film, which is responsible for the decrease in conductivity and IR reflectivity. UPS of transparent, conducting SnO_2 films has been reported for the first time. The onset of photoemission in the valence band around 2.6 ev has been explained by invoking the idea of surface states near the valence band below the Fermi level.

Antimony-doped SnO_2 films with a resistivity as low as 9×10^{-4} Ωcm were prepared by Spray pyrolysis and their electronic and optical properties have been studied by varying the antimony concentration, film thickness and deposition temperature. About 94% average transmission in the visible region and about 87% IR reflectance was obtained for SnO_2:Sb films by a systematic optimization of the preparation parameters. As the best combination, an average transmission of 88% in the visible region and an IR reflectance of 76% was possible for the *doped* SnO_2 films.

4.1.2 Phosphides

Thin film Mg/Zn_3P_2 Schottky barriers have been made and their ac small signal capacitance has been analysed. The dependence of capacitance as a function of voltage, frequency and temperature of Zn_3P_2 Schottky diode can be explained by the model of Schibli and Milnes, by considering a dominant deep level. Its energy level, capture cross section and trap density are experimentally determined by admittance spectroscopy. A single dominant trap level is observed and identified as a hole trap which is 0.5±0.01 above the top of the valence band edge. The capture probability Cp and the density of the traps have been determined to be 0.75X 10^{-14} cm^3 Sec^{-1} and 0.97 X 10^{16} cm^{-3} respectively.

4.2 Thick film materials (7-5-004)

1.Cadmium oxide based thick film resistors (TFRs)

CdO emerges out as a good TFR material based on the economic considerations and thick film processing requirements. Chemical stability of the CdO is the primary requisite. It has semimetallic conductivity. Controlled valence technique is used to stabilize CdO. The dopants, PbO, Bi_2O_3 and ZnO are incorporated through their glasses. The addition was found to follow Vegard's law. The electrical properties like ρs and TCR show a trend with respect to the glass composition, its content and firing temperature. The results indicate the possibility of production of a good range of stable TFRs by carefully controlling the processing parameters.

2. Thick resistive films of $Bi_2Ru_2O_7$

$Bi_2Ru_2O_7$ is the most widely used TFR material today. It is one of the most stable oxides of Ru, and is also highly conducting. It was prepared at a comparitively lower temperature of 810° /hr . without refiring. XPS, XRD, thermal analysis and conductivity measurements revealed the presence of adsorbed oxygen on the surface. Clustering of the ruthenate particles has also been observed. NCL designed resistor pattern consisting of six resistors and one pot-track was used for ρs and TCR measurements. The results indicate the possibility of obtaining low TCR values (±-25 ppm per °C)

3. Thick film microelectronics

Thick film materials section of NCL is closely associated with the CSIR funded project. Performance study of thick film circuits using indigenous pastes and applications to functional hybrids (with built in sensors) , at the university of poona in the capacity of project advisor. Considerable progress has been achieved in this area .All the conductor and resistor materials are specially formulated at NCL to meet the circuit design parameters. The thick film processing conditions have been optimised. A third hybrid microcircuit called hybrid optocoupler was designed, fabricated and studied. Hybrid amplifier and ASJABLE multivibrator circuits have already been reported in this scheme.

4. Masking medium for CdS-Cu_2S solar cells.

This was developed at NCL for masking CdS layer leaving a window for the formation of Cu_2S layer. This special thick film formulation could easily be removed from the CdS layer without damage after the Cu_2S layer was formed for further solar cell characterization.

5. Special silver paste formulation

A special silver paste was formulated for bonding the lead wires of bead thermistors onto the Mylar films for IMD, Poona, for use in their joint programme with ISRO.

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5.1 Synthetic pyrethroids (8-1-03S7)

5.1.1 Alphamethrin and (±) cis-DV acid

(±) cis-2,2-Dimethyl-3-(2,2-dichlorovinyl) cyclopropane carboxylic acid, commonly known as (±) ***cis*** DV acid, is an important intermediate in the synthesis of the highly potent photostable pyrethroid, alphamethrin. Two synthetic routes have been developed for (±) ***cis***-DV acid. The conversion of (±) ***cis***-DV acid into alphamethrin is being studied.

5.1.2 Pyrethroids from (+)-3-carene

The synthesis of 3-phenoxybenzyl IR ***cis***-2,2-dimethyl-3n-propyl cyclopropanecarboxylate showing moderately good insecticidal activity against houseflies has been carried out from (±)-3-carene. The synthesis of methyl 1S-*cis*-2,2-dimethyl-3-n-ethyl/propyl/hexyl/decyl-cyclopropane carboxylates and the corresponding l-hydroxymethyl cyclopropanes has also been achieved from (±)-3-carene. It is proposed to test some of the esters prepared from the above mentioned acid and alcohol moieties for possible miticidal activity.

5.1.3 DV acid (8-9-00S7)

2,2-Dimethyl-3-(2,2-dichlorovinyl) cyclopropane-l-carboxylic acid as a mixture of ***(±) cis*** and **(±) trans**-isomers roughly in 45:55 proportion and commonly known as DV acid is the acid moiety of commercially important pyrethroids like permethrin and cypermethrin. A three step laboratory scale process is being standardised for DV acid starting from 3-methyl-but-2-ene-l-l.

5.1.4 1,2, and 2,3-Secopyrethroids

Synthesis of 3-phenoxybenzyl 3-alkyl-3-phenyl/p-substituted phenyl and 3-phenoxybenzyl 2-alkyl-3-phenyl/p-substituted phenyl propionates has been carried out with a view to evaluating them for insecticidal properties. Some of the esters exhibited moderate insedcticidal activity.

5.2 Pheromones

The total synthesis of phermones namely E,E,10,12-hexadecadienal and Z-11-octadecenal was completed. It has been established that these two pheromones act as an efficient insect attractant for the pests attacking cotton plants when used in combination in a 15:1 ratio. Both the syntheses were completed from a common starting material viz. tetrahydrofurfuryl alcohol.

The synthesis of other two pheromones, (4E, 7Z)-4, 7-tridecadienylacetate and (4E, 7Z, 10Z)-4,7,10-tridecatrienylacetate have been completed. Six carbon acetylinic moiety is common for both the pheromones and this was prepared from propargyl bromide and acrolein.

The insect sex pheromones, E-3, 7-dimethyl-2, 7-octadienylpropionate, isolated from the San Jose scale quadra, *Spidhotus pernicuors* is being synthesised starting from geraniol.

Synthesis of 4(RS) 8(S), 1,8-dimethyl decanal, a pheromone of red flour beetles, has been achieved from 7-hydroxy citronellal.

5.3 1,2,4-Triazole fungicides

The recent introduction in the market of 1,2,4-triazole derivatives as both systemic and non-systemic fungicides represents a breakthrough in the control of fungal disease on cereals, fruits and vegetables.

Work on the synthesis of 1,2,4-triazole derivatives, culminated in the synthesis of 2,6-diphenyl-8H (1,2,4) triazolo (5,1-C) (1,4) oxazine and its thiazine analogue. These compounds represent two new fused by bicyclo systems containing the 1,2,4-triazole unit. In addition, several new N-alkylated, 3-substituted and 3,5-disubstituted triazoles with well-defined regio structures were prepared.

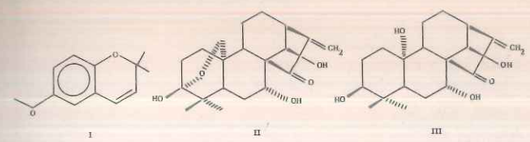
5.4 Natural products of biochemical interest

Sixty plant extracts including new and some older extracts were screened for various insect control activities. Notable insecticidal and insect-antifeedant activities were displayed by some of these extracts.

Follow up work on the isolation and identification of active principles by detailed fractionation of the extract monitored by bioassay led to the isolation of a known chromene, desmethoxyencecalin (I) exhibiting oviposition deterrent activity in potato tuber moth. Similar fractionation of other extracts resulted in the isolation and identification of a number of known and new sesquiterpene lactones, diterpenes and flavonoids. Two of the interesting diterpenes are plecostonol (II) and a related compound coestinol (III) and the structure of the former was established by X-ray crystallography.

In continuation of the earlier work on synthetic JH analogues, more compounds were prepared showing significant mosquito controlling activity.

Collaborative work with National Institute of Virology, Pune, has resulted in the identification of three plant extracts exhibiting good antimalarial activity.



I II III

5.5 Controlled release technology (8-5-3S56)

5.5.1 CR Carbofuran systems: Encapsulation of carbofuran

i) UF Resin system: Microencapsulation of carbofuran in urea resin condensates was studied in detail and a procedure for studying the release kinetics of these products under stirred conditions in water was worked out. Release data for all the experimental batches as well as for the standardised starch-xanthate formulation and commercial FURADAN 3G formulation were collected.

The urea resin encapsulated carbofuran system is in the form of very fine particles (10-100 microns). This is quite suitable for application as seed-coat, for which, at present, FURADAN 50SP, a commercial formulation (active ingredient (a.i.) content 50%) of carbofuran marketed by Rallis India Ltd., is available. Hence, based on the *invitro* release data, a urea resin CR carbofuran formulation containing 50% a.i. was standardised which could be used for seed-coat applications.

ii) Starch-UF system: A new encapsulation system is being developed using starch as the polymer matrix and urea resin as the crosslinking agent. This obviates the necessity of conversion of starch to xanthate which is foul smelling and unstable. The new system is found suitable for encapsulation both liquids and solids and has the added advantage of functioning under mildly acidic reaction conditions unlike the xanthate, borate and calcium adduct which require alkaline conditions under which most of the pesticides are unstable.

Toxicity: The oral LD 50 values of the UF resin seed-coat formulation were determined by Rallis India Ltd. on rat and mice. These data showed that the NCL formulation is safer by a factor of 3 to 4 than the commercial formulation.

Field evaluation: The field evaluation of the action of NCL's starch-xanthate granular formulation against stem-borer in the rice plant was carried out at the Agricultural Research Station, Karjat, during 1984 kharif and 1985 rabi seasons. The results were inconclusive and further trials are being conducted during 1986 rabi season.

Seed-coating trials were conducted in sorghum cultivation against shoot-fly at the Mahatma Phule Agricultural University, Rahuri, during kharif 85 and at Nimbkar Agricultural Research Institute, Phaltan, during rabi 85-86 with the NCL UF resin formulation. The results from Rahuri show a definite cost benefit to be obtained with the formulation, which is as effective even at 3% a.i. coating as Furadan 50SP at 5%. The results from Phaltan are awaited. Seed-coat trials against sucking pests in cotton cultivation has also been intiated at Phaltan.

NCL's starch-xanthate formulation is also being tested at CTRIRS, Vedasandur against root-knot x nematodes attacking tobacco.

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6. PLANT TISSUE CULTURE

6.1 Plant tissue culture for agriculture and forestry (9-1-001) : Conservation of endangered plant species - seed biology and tissue culture (17-1-001(G))

During this period the following locations were visited to identify that plants species and the location, and to collect budwood material for tissue culturing.

Plant species	Location
1. *Delphinium malabaricum'*	Purander (Maharashtra)
2. *Vanilla walkeriae*	Parai forest, Nilgiri Dt., Tamil Nadu
3. *Vateria macrocarpa*	Muthikulam (Kerala)
4. *Vernonia shevarouyensis*	Shervarayan Hills (Tamil Nadu)
5. *Cycas beddomei*	Tirumalai Hills (A.P.)
6. *Syzygium travancoricum*	Trivandrum (Kerala)
7. *Cyathea spinulosa*	Coonoor (Tamil Nadu)
8. *Pterocarpus santalinus*	Tirumalai Hills (A.P.)
9. *Hopea canarensis*	South Canara (Karnataka)
10. *Ceropegia beddomei*	Idukki (Kerala)

Two of the 10 endangered species, viz. *Hopea canarensis* and *Ceropegia beddomei,* could not be located. *Hopea canarensis* in particular, has not been re-located after it was first reported in 1917. Budwood of the other *species* was collected for tissue culture studies and success achieved with *Delphinium malabaricum.* The regenerated plants are being evaluated in the field.

In the case of *Vanilla walkeriae,* an orchid, a medium has recently been developed in which stemp nodal explants have been observed to sprout and develop into muitiple shoots in some cases. Efforts are now being made to induce rooting.

Efforts are being continued to develop tissue culture techniques for the other plants induced in the project.

6.2 Technology transfer, biotechnological evaluation and clonal multiplication of eucalyptus, bamboo and salvadora (17-3-001 (G))

As part of the work in this project, several visits were made by NCL staff to different states and user industries participating in this project. Budwood material collected form *Eucalyptus tereticornis, E. camaldulensis,* Bamboo *(D. Strictus)* and *Salvadora* trees growing in plantations, natural forests or near the sea shore. Budwood was collected from 29 elite trees of *E. tereticomis,* 26 of *E. camaldulenis,* and 13 of *Salvadora persica.* Cultures have now been established from seven elite trees of *E. tereticornis,* four of *E. camaldulensis* and five of *S. persica.* In addition cultures have been isolated form seedlings of bamboo *(D. Strictus)* raised from seeds obtained from different states. All these cultures are now at the multiplication stage and will be transferred to polybags for trials at the appropriate time. In addition preliminary results have been obtained in experiments aimed at cutting down the cost intensive stages in plant production and to reduce infection.

The data obtained under this project are being computerised. As part of the programme of work under this project a short term workshop was conducted at NCL on Application of Tissue Culture to Forestry which was attended by the representatives of the different participating agencies.

6.3 Induction of empbryogenesis and organogenesis

(a) Rice - Embryogenic callus was obtained from mature zygotic embryos of the three rice varieties, K-184, IR-8 and Jays. The somatic embryos obtained from the respective varieties were separated, germinated and transferred to soil. The embryogenic nature of the tissue is being confirmed histologically.

(b) Eucalyptus - Organogenesis and somatic embryogenesis have been obtained in *Eucalyptus camaldulensis* and *E. citirodora* respectively. Organogenesis was induced in callus obtained form leaf explants of *E. Camaldulensis,* where as somatic embryogenesis occurred on zygotic embryo explants. The origin of the adventituous shoots and embryoids is being studied.

6.4 Isoaltion of somaclonal variants

Studies on the isolation of callus cultures tolerant to salt stress were carried out with sugarcane, rice and eucalyptus. Cell lines with salt-tolerance varying from 5000 to 15,000 ppm for the different plants are present in culture.

6.5 Genetic modification of plants through protoplast technology (17-2-001)

The main highlights of the work on protoplast technology have been the following :

6.5.1 Protoplast regeneration studies in moth bean

Callus protoplasts of moth bean *(Vigna aconitifolia)* a drought resistant grain legume have been regenerated into shoots. This is the first published report of a

regenration from callus tissue for a grain legume. The cell colonies derived from protoplasts isolated from shoot-apice derived callus differentiated on basal medium lacking phytohormones. The standardized methodology of protoplast regeneration is being verified with protoplasts of other genotypes.

(i) Morphogentic studies in moth bean

The whole plants obtained from various explants of moth bean, such as shoot apices, shoot-apice derived calli and cotyledons, were rooted successfully with a high percentage of survival and transferred to the field.

(ii) SEM analysis of organogenetic and non-organogenetic callus of moth bean

Scanning electron microscopic analysis of organogenetic and non-organogenetic callus tissue was done to elucidate the nature of development of callus tissue during differentiation. The morphological features observed in these calli were compared with the protoplast derived calli capable of organogenesis on the same medium (MS) depending on the presence or absence of growth regulators.

6.5.2 Protoplast regeneration studies in cow pea

Mesophyll protoplasts of cow pea *(Vigna unguiculate)* on culture in an appropriate medium divided and formed a callus tissue. The proroplast-derived-calli are being studied for differentiation.

Various parameters such as leaf age, enzyme concentration mode of incubation, viability of protoplasts and plating efficiency in various media have been studied in detail.

6.5.3 Embryogenic calli and somatic embryogenesis in wheat

Embryogenic calli/suspension cultures are the prerequisites fo the successful isolation of cereal protoplasts and their regeneration. During the establishment of embryogenic calli in wheat, more than 120 plants obtained through somatic embryogenesis have been transferred to the field. A study of various parameters governing somatic embryogenesis and the elucidation of successive steps of somatic embryogenesis through SEM are the novel features of the work.

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7. POLYMER SCIENCE AND ENGINEERING

7.1 Polyphenylene sulphide (PPS) (10-1-567(c))

This is a development project jointly organised with Shri Ram Fibres (SRF), Madras. The objective of the project is to scale up the laboratory process for producing coating grade polyphenylene sulphide, and to develop the guidelines for processing the polymer. Another objective is to develop a laboratory scale process for moulding grade PPS powder.

A process for synthesis of PPS has been demonstrated on a laboratory scale. The polymer powder produced by the process can be used directly for corrosion resistant coating applications. Coating trials were successfully conducted in 1984 with Ogale Industries. The crystallization behaviour of the polymer has been studied, on the basis of which guidelines for processing have been arrived at for injection moulding. The structure development in solid-state processing of PPS and HDPE blends has been investigated.

The polymerization process for producing coating grade PPS has been successfully duplicated at SRF, Madras, in a 2-litre reactor. Experiments have been conducted to finalize the polymer separation process and to ascertain solvent recovery. The solid state polymerization process has been demonstrated in a glassware set-up at 30 gm per batch scale.

Further work has been planned to scale up the solid-state polymerization of the powder obtained in the solution, polymerization process to a 1 kg per batch level. The higher molecular weight polymer obtained in the solid-state polymerization will then be compounded with glass fibres to produce the reinforced grade PPS which constitutes 90 percent of the potential market requirements. Further optimisation and scale-up of the synthesis/separation process will be done in collaboration with SRF. Technical advice will be given to SRF on coating and moulding applications of PPS.

7.2 Sulfochlorinated polyethlene (SCPE)(10-4-006)

Designs for a semi-commercial (150 TPA) scale plant for producing sulfochlorinated polyethylene (SCPE-I) were submitted to Shriram Rayons, on the basis of which Davy Powergas (India) are setting up the plant at Kota. Work was also started on a new grade of sulfochlorinated polyethylene (SCPE-II), which has properties far superior to those of SCPE-I. A pressure reaction method has been developed on laboratory scale, and pilot plant trials will commence shortly.

7.3 Drag reducers for oil transport (10-7-567(C))

The objective of the project is to develop a drag reducing polymer for the pipe line transport of crude oil, particularly the Assam crude, and also for the North Gujarat crude. In addition, efforts are to be made to develop a pour-point depressant for the North Gujarat crude.

Preliminary tests were carried out in the 1/4 inch pipe line test section. Two of the polymers synthesised have shown promising results. The performance of these polymers is found to be comparable to that of the commercial polymer (imported). The NCL polymer has also been found to give drag reduction in a test carried out in the 2-inch pipe line loop of MERADO, Pune.

Extensive experiments are being conducted to evaluate the drag reducing efficacy of these polymers under various conditions and to develop scale-up criteria. Both the NCL pipeline rig and the MERADO rig would be used in the experiments.

7.4 Polymer alloy resins for composites phase-II-product development (10-8-006(G))

The project objective is to make moulded products with PET/PMMA alloys and PPS/HDPE alloys. These two alloy systems have been demonstrated in phase-1 of the project at NCL.

Melt compounding of two alloy systems, namely PPS/HDPE and PET/PMMA has been successfully completed. The melt compounding conditions for preparation of the alloys were defined on the basis of the basic rheology and thermal data generated on the comonent polymers. The thermal and viscoelastic characterization of the alloys has been completed. On the basis of the results, the property advantages anticipated due to alloying have been confirmed. For example, alloying of PPS with HDPE has shown to improve its impact resistance in addition to reducing its cost. Also, the alloying of PETP with PMMA has resulted in accelerated crystallization leading to shorter moulding cycles. The toughness and impact resistance of PETP is also improved. Injection moulding of PET/PMMA alloys has been successfully demonsdrated.

Joint development efforts have been initiated with Polyolefin Industries Limited (PIL) for the transfer of the technology for PPS/HDPE alloys. In continuation of the phase-1 of the project, the effect of the grade and composition of HDPE in HDPE-rich PPS/HDPE alloys has been investigated. On the basis of the properties, two specific compositions will be selected for scale up and product development in collaboration with PIL.

7.5 Water absorbing polymer (10-9-006 (sp)

This project has been sponsored by Indian Organic Chemicals Limited. Based on the knowhow developed at NCL, the company has installed a semicommercial plant having a designed capacity of 200 TPA. The product is being extensively tested by the ICAR laboratories, state agricultural departments and universities for agricultural, horticultural and forestry applications. The trials have been highly encouraging and the cost-benefit ratios found to be very attractive. The company has received a letter of intent from the Government for the production of 5000 TPA of the product and is taking steps to implement the project in a phased manner.

7.6 Polymeric materials based on cashewnut shell liquid (CNSL) (10-10-006(G))

The project objective is to demonstrate a low cost hut made from composite panels moulded from cellulosic fillers and reinforcements, and CNSL based phenolic resins. In phase-1 of the project, the technical feasibility of preparing moulded composite panels has been successfully demonstrated.

The synthesis of polymeric liquid resins has been demostrated by co-polymerisation of CNSL and phenol with formaldehyde. Solid state and foamed cast products have been demonstrated from these phenolic resins. The use of mineral fillers and agro-based fillers such as peanut shell flour has been successfully attempted. The cellular and solid castings can be readily drilled, machined and generally worked upon like wood. Potential applications include panels for rural housing, partition boards, electrical fittings etc.

It is proposed to optimise the conditions of synthesis of phenolic resins from CNSL/phenol, and their curing conditions. Mechanical testing of cast resins will be conducted to select the proper filler combinations and reinforcements. Large scale moulding of panels and demonstrations of a life-size hut will be carried out in phase-2 of the project, if approved by DST.

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8. POLYMER SYNTHESIS AND MODIFICATIONS

8.1 Hydroxy terminated polybutadiene (HTPB) (11-6-567- SP)

The preparation of hydroxy terminated polybutadiene with a number-average molecular weight between 2500 and 3000 was demonstrated to ERDL on 800 gm/batch scale in a two gallon reactor. The polymers obtained in the batches were evaluated by ERDL scientists and reported to be satisfactory. Four batches were run in the presence of ERDL scientists in a 75 litre autoclave. The yields were around 7 kg/batch. The values of number-average molecular weight, functionality, hydroxyl number, molecular weight distribution, microstructure, etc. in the required range for these polymers and their performance was reported to be satisfactory.

8.2 Polymers from renewable resources (11-9-567)

Castable polyurethanes were prepared from castor oil, transesterified castor polyols, difunctional castor oil, isocyanate terminated prepolymers prepared from blends of castor oil with polyethers, and their physical properties evaluated. Transesterified castor polyols gave hard rubbers whereas the difunctional castor oil gave in soft rubbers. Catyur-21 (sodium chloride complex of methylene dianiline), when employed as a chain extender with prepolymers of castor oil resulted in hard rubbers. Isocyanate terminated prepolymers prepared from blends of castor oil and polyether gave castable rubber with satisfactory physical properties. Rubbers with high strength, hardness and good elongation were obtained from isocyanate terminated prepolymers of polyesters using butane diol as a chain extender.

A one-component polyurethane coating based on castor oil has been developed. The coatings have satisfactory shelf life (six times longer than encountered normally) and were found to be satisfactory for drying time and film properties, such as scratch hardness, abrasion resistance, flexibility, water and chemical resistance, etc. Incorporating certain additives was observed to substantially improve the storage stability of the castor polyols used for encapsulating cable joints and result in defect-free castings.

8.3 Thermoplastic polyurethanes (11-10-567)

Preparation of poly(oxytetramethylene)diol by the cationic polymerization of tetrahydrofuran was carried out using sodium perchlorate as the catalyst. Polymers in the required molecular weight range (2000-2500) and functionality (~ 2.0) were obtained. A few polymerization runs were carried out to obtain polyesters from adipic acid and 1,4-butyl diol in about 100 gm polymer/batch. Initially, the acid value of the polyesters were higher than desired. By suitable modification, polyesters with the required molecular weight and acid number were prepared.

8.4 Engineering plastics (Modified polyphenylene oxide resins) (11-11-567)

Polyphenylene oxide (PPO) based resins are attractive, stiff and tough materials which can be used in a wide temperature range (−40°C to 130°C). Because of their desirable properties such as excellent dimensional stability under hot conditions and at a high voltage, and low water absorption, they are among the most widely used engineering plastics in electrical/electronic and transportation industries.

Oxidative coupling polymerization reaction of 2,6-dimethyl phenol to yied PPO of required molecular weight in 90-92 yield has been standardized in a 100 gm/batch scale. A non-conventional laboratory scale process for the preparation of PPO blend with polystyrene has been standardized in a 500 gm/batch scale for one of the basic grades. The physical properties evaluated for the blends were in the range reported for the equivalent commercial grade.

8.5 Polymers for electronics (11-12-567)

Dimethyl malemide group containing methacrylate polymers have been reported to exhibit high photocrosslinking efficiency and hence can find application as negative resists. Three monomers, viz. 2-(dimethyl maleimido) ethyl methacrylate, 3-(dimethyl maleimido) propyl methacrylate and 4-(dimethyl maleimido) phenyl methacrylate, were synthesized from maleic anhydride in a three-step process in good yields. They polymerized readily with free radical initiator, azobis isobutyronitrile. The polymer of 3-(dimethyl maleimido) propyl methacrylate had a molecular weight of 2 x 10^5 and a molecular weight polydispersity of 3.8 Its microstructure, determined by NMR, showed that the mechanism of polymerization is in conformity with first-order Markov statistics. TGA showed that the polymer undergoes a single-stage degradation (at 350-400°C) in contrast to two-stage degradation observed for polymethyl methacrylate. The monomer, 4-(dimethyl maleimido) phenyl methacrylate, exhibited orthorhombic crystalline structure with space group F_{2dd} as analysed by X-ray.

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9.1 Process simulation, optimisation and synthesis (12-1-067)

9.1.1 Computer simulation of IPCL's naphtha reformer

The simulation model developed earlier was applied to plant data collected over a given catalyst cycle. The kinetic constants were obtained by matching the predictions of the model with the observed performance characteristics of the plant. It was found that parameters of importance like the C_8 aromatics yield, hydrogen production, percent saturates in the reformate, temperature drops across reactors etc. could be predicted over the entire cycle within the limits of accuracy of plant observations. The model is now being applied to other cycles to incorporate the cycle-to-cycle variation due to catalyst deactivation.

9.1.2 Resilience of heat exchanger networks

One of the requirements of a heat exchanger network is that in addition to being optimal from the point of view of energy requirements, it should remain so even under changed process conditions. The resilience aspects of a typical network arising in a particular process plant was investigated to evolve an optimal policy of operation in presence of changing process condition.

9.1.3 Modelling and simulation in gas liquid reactions

The problem of mass transfer accompanied by multiple equilibrium reactions was solved, accounting for gas side resistance as well as volatile products. The case of simultaneous absorption of two gases followed by their mutual reaction in the liquid phase in a semibatch reactor was also investigated. The solution was used for modelling the industrially important hydroformylation process which involves rather complex liquid phase reactions. The effects of parameters like agitation speed, reactant ratio etc. on the overall rate were derived. The regions of multiple steady states were identified. The non-isothermal effects in gas absorption followed by an exothermic bimolecular reaction were investigated wherein the depletion of liquid reactant was accounted for, for the first time.

9.2 Project design (12-2-067)

Design work was undertaken for several projects including opium alkaloids, polyphenylene oxide, hypalon, MEK and conversion of cellulose to glucose. Cost estimates were worked out for polycrylamide and encapsulated carbofuran.

9.3 Regular packing development (12-3-006(c))

The aim of the project is to develop regular packings for use in distillation columns, in particular, for those operating under reduced pressure. These packings have high efficiency of mass transfer, low HETP and low pressure drop.

Two types of regular packings were tested in the pilot plant. Characterization of these packings was done under total reflux condition at various liquid/vapour loading. Experiments were also conducted to study the hydrodynamics at different liquid to vapour ratios. Pall rings were studied under identical conditions for the purpose of comparison. Both the regular packings are found to be better than Pall rings. Typically their HETP is about 50% lower and their pressure drop is about 25% lower than that of Pall rings under identical conditions. One chemical unit has shown keen interest in installing these packings in its distillation column and the procedure for the installation of the packings is being finalised.

9.4 Heat pumps (12-4-006(c))

Heat pumps are devices aimed at reducing the primary energy consumption of processes by recovery, upgradation and recycle of waste energy. There is a growing awareness in our industry of the potential of heat pumps in industrial applications. This project is aimed at developing expertise in the area of heat pumps in general and utilizing the expertise to help industry to install heat pumps for energy conservation. This project has been taken up in collaboration with the University of Salford, U.K. which has developed considerable expertise in the area, in the last ten years. The current status and the achievements in various aspects are described below.

9.4.1 Experimental programme

A fully instrumented heat pump assisted dryer is being operated to study its performance and collect design data under different operating conditions, including different working fluids. A fully instrumented water-to-water heat pump is being operated to study its performance and collect design data under different operating conditions. The working fluids include single fluorochlorocarbons as well as their non-azeotropic mixtures. Preliminary feasibility studies are being conducted on heat pump assisted distillations in specific systems like ethanol-water. Experimental studies will be shortly undertaken on a fully instrumented computer controlled unit. Stability of different single and mixed working fluids is being studied using lubricating oils available indigenously. Studies are in progress for the collection of experimental data on the properties of

potential working pairs and for the development of predictive methods.

9.4.2 Industrial collaborations

Since heat pumps are economically attractive in several industrial applications, considerable interest has been shown by industries in proposals for incorporating heat pumps in industrial operations. Preliminary designs and economic evaluations were worked out for specific applications like timber drying, process heat recovery and ethanol distillations for several potential users.

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10. TIME TARGETED PROJECTS

10.1 Ethylene to ethylene oxide

An integrated pilot plant incorporating a single tube reactor was commissioned. The pilot plant operation was standardised using a batch of manufactured catalyst. A few methods of manufacturing the catalyst were attempted and a batch of catalyst acceptable for pilot plant trials has been obtained. The operation of the pilot plant will be continued for optimizing the process conditions for the NCL catalyst.

10.2 Molasses to ethanol

The immobilized yeast cell catalyst had been run in a reactor of 10 lit/day ethanol capacity continuously. The major problems were the strength and life of the catalyst. Investigations have been initiated to ascertain the parameters responsible for the above difficulties. The larger pilot plant of 100 lit/day ethanol capacity is proposed to be erected after solving the above mentioned problems.

10.3 Ethylene from ethanol

A pilot plant of 2-3 kg/hr ethylene was operated using an alumina catalyst. The optimum process conditions for this catalyst were established. A new zeolite catalyst developed in the laboratory was subsequently taken up for testing in the pilot plant. On-line facilities for analysing ethylene before and after purification have been established. The process data for this catalyst is being collected.

10.4 Industrial application of synthetic zeolites

NCL has developed several zeolite catalysts named as Encilites. Scale up studies were carried out to prepare up to 5 kg of catalyst per batch at NCL. The process control and quality control steps were worked out. NCL scientists were associated with the industrial organisation that manufactured the catalyst.

10.5 Chlorchrysanthamate

Chlorchrysanthamate is a key intermediate in the manufacture of synthetic pyrethroid. The technology for the manufacture of this intermediate is not available in the country. Exploratory work on the development of a process for chlorchrysanthamate has been undertaken with a view to identifying a route to be developed into an industrial process on behalf of NOCIL, Bombay.

10.6 Methylation of morphine to codeine

Government Optium and Alkaloid Works at Neemuch implemented a process developed at NCL for the methylation of morphine to codeine using a phase-transfer catalyst. NCL continued the work further and developed another process in which conversions and yields were over 90%. This new process was implemented at their Ghazipur factory successfully. NCL scientists provided designs for the plant and assistance during start up.

developed

10.7 Monochloromethylacetoacetamide

This is an intermediate in the manufacture of the pesticide, monochrotophos. Laboratory scale studies on chlorination of methylacetoacetamide have been started with a view to collecting data for the design of an integrated pilot plant based on a continuous process. The work is being carried out on behalf of Colour Chem Ltd., Bombay.

10.8 Acrylic esters

IPCL has established a plant for the manufacture of acrylic esters based on the process developed at NCL. The plant was operated successfully when the products of the required specifications were obtained. On continuous operation over a period of time it was found that the consumption of raw materials were higher than the expected. Additional investigations were, therefore, carried out at NCL and the results were used to improve the operation of the plant at IPCL. Considerable improvement has been achieved at the plant. NCL continues to be associated with the process and plant improvements.

10.9 Vitamin B_6

A new six-step process has been developed in the laboratory. A pilot plant reactor assembly of 2 kg/ batch capacity was erected at NCL for collecting engineering data for the design of the commercial plant and also to develop the process control steps in its operation. A few experiments on the first three synthesis steps have been carried out in the pilot plant.

10.10 Trichlorosilane

In the preparation of polycrystalline silicon, silicon tetrachloride is obtained as a byproduct. The conversion of silicon tetrachloride to trichlorosilane has been carried out on a scale of 0.5 kg/hr. This step will be incorporated to the NCL process for polycrystalline silicon.

10.11 Glyphosate

It is a systemic, non-residual post emergent herbicide

which can be used very effectively on deep rooted perennials, annuals and biennial species of wide varieties of grasses, sedges and broad leaf weeds. Even a single spray of glyphosate can control the growth of weeds for a period of 2-3 months. In India this imported herbicide is used extensively in tea plantations.

A commercially viable process has been developed using indigenously available raw materials.

10.12 Sucrose esters

After developing various methods for the preparation of sucrose esters and the different catalysts required for these processes, the selection of the right methods, using different edible and non-edible oils, were made to get a good quality product in optimum yields.

The scale-up work upto the bench scale size has been completed. Different sucrose esters so obtained were formulated in order to boost their detergent and other surfactant properties with a very low concentration of the active ingredients. The surfactant properties of sucrose esters compare favourably with those of the sodium dodecylbenzenesulfonate, the most commonly used petrochemical-based surfactant. A few more scale-up experiments have been planned on a 10 kg.per batch scale.

OTHER BASIC AND EXPLORATORY PROJECTS

1. Chloramphenicol (0-7-003)

Phenylalaninol was resolved by employing ''Swing resolution'' technique on one of its derivatives. Introduction of functional groups at the benzylic position of phenylalaninol was investigated as a part of this study and a number of blocking groups have been employed to block the NH_2 and OH group of phenylalaninol.

The methods reported in literature for the preparation of styrene bromohydrin are not suitable for large scale production. A convenient method has been developed for the preparation of pure styrene bromohydrin, an intermediate for the manufacture of chloramphenicol.

Racemic *cis*-4-amino-5-phenyl-1. 3-dioxane has been resolved employing tartaric acid. Work on the conversion of R, R-aminonyl-dioxane to RR-2-amino-1-phenylpropane-1, 3-diol is in progress. A commercial sample of RR aminodiol was acetylated, nitrated and deblocked to furnish L-base.

The regioselective deoxyganation of benzylic hydroxyl group has been achieved to utilise the unwanted S, S-enantiomer of 2-amino-l-phenylpropane-1, 3-diol, a by-product in the chloramphenicol industry.

2. New perfumery products from longifolene (0-31-0035)

The transformation of longifolene into long-β-nozigiku alcohol/longicyclenyl alcohol, occurring in Japanese sugi/hinoki essential oils, has been achieved. Oxonium ion chemistry of some longibornane-based secondary carbinols has provided, for the first time, a direct chemical proof for the Berson mechanism of rearrangement of longifolene to isolonifolene. Concepts like neighbouring group participation/non-classical carbonation have been invoked to explain strange product development in some reactions of longifolene. Extensive studies on molecular rearrangements invoving migration to electron-deficient carbon/nitrogen, in longifolene chemistry, have been made.

3. Polymer characterization (0-22-005)

In view of the observation that the expansion coefficients for polymethacrylic acid and hydrolysed polyacrylamide cannot be satisfactorily accounted by the existing microion expansion theories, an empirical method has been developed to account for the dimensions of polyelectrolytes in solution. Electrostatic interactions are assumed to affect only the short range interactions and the volume exclusion effects are assumed to be similar to those observed for neutral macromolecules. The results obtained in the two systems are in conformity with the empirical method proposed. It was also observed that the osmotic second virial coefficients obtained for polymethacrylic acid solutions could be similarly accounted for in terms of a charge-density dependent Donnan term and a molecular weight dependent term valid for neutral macromolecules.

Incompatibility in macromolecular blends is a general behaviour observed with most of the systems. However, there are a few two component polymer blends which exhibit compatibility over a wide range of composition and polyphenylene oxide and polystyrene is one such miscible system. Specific interactions of the groups present in the two polymers is a necessary criteria for overcoming the unfavourable entropy contribution to bring about miscibility, in the two component polymer blends. Assuming these interactions are site specific and independent of the polymer molecules to which the groups belong, by analogy with difunctional polycondensation reaction a most probable distribution for the sizes of the complex molecules in solution is predicted. The observed size distribution in the PPO:PS blends is in conformity.

4. Polymer modification (0-32-005)

The objective is to investigate the feasibility of using cellulosic material from various sources including agricultural wastes, to obtain polymers for encapusulating pesticides for controlled release.

In continuation of the previously reported work, investigations have been extended to the utilization of agricultural waste products such as peanut shell, rice straw etc. with carbofuran as encapsulant.

The release is governed by the degree of xanthation which is dependent on activation of cellulose. A series of experiments were conducted carrying out activation at different temperatures. Crystallinity was reduced and amorphicity increase with increasing temperature of activation as indicated by x-ray studies. Further xanthation of peanut shell powder of different temperatures showed that the degree of xanthation increases with increase in amorphicity of the cellulose and the release rates. It was found that the release rates with peanut shell powder activated at room temperature were comparable to that of strach matrix.

Further experiments were carried out with peanut shell cellulose, rice straw and rice straw cellulose by

carrying out activation at room temperature using pure carbofuran as core material.

5. Studies on UV stable polymers for solar application (0-40-004)

Earlier studies in this laboratory have shown the dielectric and piezoelectric properties of $Pb_{0.94}Sr_{0.06}(Zr_{0.53}\ Ti_{0.47}O_3$ are improved to a great extent when the material was modifiedf with small amounts of Cr_2O_3, $MnO_2$2, CO_2O_3 andf U_3O_8. To explore further the role of dopants on the lattice parameters and microstructure of the said ceramics, the same compositions used in earlier study, were examined by scanning electron microscopy (SEM) and X-ray diffraction (XRD)f measurements. The unit cell volumes showed an increase for Cr_2O_3-Co_2)3-and U_3O_8-doped compositions and a decrease for MnO_2-doped compsotions. The increase of unit cell volumes the ionic radius of U_4 + (r=0.97A) is larger and Mn_4 + (r+0.60A) is smaller than the average ionic radius of Ti_4 +and Zr_4 + which is 0.74 A. The discrepency that the unit cell volumes for Cr_3O_3- and Co_2)3-doped compositions showed an increase even though the ionic radii of Cr_3 +(r+0.63 A) and Co_3 +(r=0/63A) are smaller than the average ionic radius of Ti_4+ and Zr_4+ is probably due to interestitial addition of foreign atoms instead of substitutional one in the crystal structure in this case. The axial ratio, Co/ao for the undoped composition is 1.023 which showed a decrease with increase of doping material concentration. Further, the Curie temperature, Tc (355C for undoped composition) was found to be decreased with decrease of tetragonal distortion as reflected by the axial ratio. Axial ratios are essentially determined by modifying cations which in term regulate the transition temperature, Tc. The average grain size for the unmodified ceramic was found to be 10.7 um. The addition of small amounts of dopants had controlled the grain growth to give rise the average grian size of 6.4 to 9.5 um which appeared to have some effect on the improvement of the piezoelectric properties so as to use them in ceramic electric wave filters.

Further fine oxide powders of PLZT ceramics with submicron particle size was prepared by coprecipitation method from the four metal alkoxides. The PLZT compacts prepared by this method were sintered with different experimental conditions at 1200°C. The density of the sintered product was improved to some extent.

6. Chemical reactions on solid surfaces (0-42-004)

The work on stabilized $Mn_{1-x}\ Zn_xO$ was continued in addition to the work on stabilization of FeO using trivalent ions such as Cr^{3+} and Al^{3+} Characterization of stabilized oxides was done by various techniques such as XRD, chemical analysis, thermogravimetry, optical and electrical property measurements. However, this could not reveal the stabilization process in these oxides. X-ray photoelectron spectroscopic studies were carried out in order to understand surface morphology of these oxides and the comparative evaluation of the surface and bulk properties, XPS have revealed the presence of a few surface layers of Mn_2O_3/ZnO mixed phase protecting the bulk MnO.

The model has been supported by our results on magnetic susceptibility measurements on $Mn_{1-x}Zn_xO$ system at liquid helium temperature with low magnetic field (3∝) using SQUID magnetometer at AT and T Bell Laboratories, USA. The magnetic data brings out the spin-glass transition in stabilized MnO at 40K which is a very interesting and novel transation observed in magnetic insulators such as MnO. We have attributed this transition to the pressure of interacting $Mn3^+$ species present in stabilized MnO.

Highly unstable F is chemically passivated in incorporating Cr^{3+} Al^{3+} ions by solid solution technique and forming Fe_x O:Cr^{3+} and Fe_x O:Al^{3+} single phase materials respectively. Material characterization has been carried by standard methods. In addition, Mosabauer Effect has been employed for the characterization of Fe^{2+} in stabilized Fe_xO for freshly prepared as well as samples aged for nearly three months. This was done in order to confirm the stability of these oxides over a period of time. The results have comfirmed the chemical passivation of unstable Fe_xO

Further, the work on manganites, which have useful applications in electronic gas seasors and auto exhaust catalysts, has been taken up. Manganites of the formula AMn_2O_4 (A=Cd, Mg, Zn and Ni & Cu) were provided very interesting data on $CuMn_2O_4$ which indicate the presence of Cu^{1+} species on its surface, which may lead to a new cation distribution of the manganite.

The work on stablized oxides and manganites has been presented in National/International seminars and published in international journals.

Publications

1. Pardhy, (Mrs) S.A., Gopinathan, (Mrs) S and Gopinathan, C.,
* Titanium and tin derivatives of salicylhydrazone and 2-hydroxyacetophenone hydrazone,
Synth. React. Inorg., Metal Org. Chem. 13, 385 (1983)

2. Deshpande, (Mrs) S.S., Awasarkar, P.A., Gopinathan, (Mrs) S and Gopinathan, C.,
* New titanium (IV) chloroacetates,
Ind. J. Chem., **22A**, 1076 (1983)
3. Joseph, K., Unni, I.R., Deshpande, (Mrs) S.S., Gopinathan, (Mrs) S., Pandit , S.K., Pardhy, (Mrs) S.A., and Gopinathan, C.,
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5. Joseph, K., Gopinathan, (Mrs) S. and Gopinathan, C.,
* Hexacoordinated bis triphenylphosphine carbonyl ruthenium (II) complexes containing bidentate chelating ligands,
Synth. React. Inorg. Metal-Org. Chem., **14**, 1005 (1984)
6. Gopinathan, C.,
* A convenient method for the preparation of red carbonyl chloride solution,
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7. Joseph, K., Gopinathan, (Mrs) S. and Gopinathan, C.,
* Synthesis and characterisation of β-carboalkoxy ruthenium (II) complexes,
J.Organometallic Chem., **269**, 273 (1984)
8. Awasarkar, P.A., Deshpande, (Mrs) S.S., Gopinathan (Mrs) S. and Gopinathan, C.,
* Chelated titanium (IV) derivatives of phenolphthalein and l, l-diphenyl ethanol,
Ind. J. Chem., **23 A**, 957 (1984)
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Synthesis of (-)-secolongifolene diol : A Norrish type I photochemical approach from longicamphor,
Synthetic Communications, **15**, 331 (1985)
10. Thimma Reddy, R., and Nayak, U.R.,
A synthesis of culmorin from longifolene via 8, ll-dibromo-longibornane,
Synthetic Communications, **15**, 543 (1985)
11. Satyanarayana, N. and Nayak, U.R.,
Generation of 10-diazolongibornane from longifolene and synthesis of neolongifolene - the elusive progenitor of isolongifolene,
Synthetic Communications, **15**, 1107 (1985)
12. Goudgaon, N.M., Shitole, H.R. and Nayak, U.R.,
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Ind.J. Chem., **24B**, 350 (1985)
13. Goudgaon, N.M., and Nayak, U.R.,
8-Methyleneisolongifolane/8-methylisolongifolene : Synthesis and reactions of their epoxides with borontrifluoride-etherate,
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14. Goudgaon, N.M. and Nayak, U.R.,
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Ind.J.Chem., **24B**, 493 (1985)
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Synthesis of erythro 2-hydroxy-3-methylbutane-1, 4-dioic acid,
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Photochemistry of the isomeric longicamphors : Synthesis of (-)-secolongifolene diol,
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20. Satyanarayana, N., Shitole, H.R. and Nayak, U.R.,
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Ind.J. Chem., **24B**, 97 (1985)
21. Puranik, V.G., Tavale, S.S., Gururow, T.N., Kumar, V.A. and Natu, A.A.,
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Base induced thermal decomposition of terpenoid tosylhydrazones part I : Chemistry of diazolongibornanes,
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23. Satyanarayana, N. and Nayak, U.R.,
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Ind.J. Chem., **25B**, 28 (1986)
24. Satyanarayana, N. and Nayak, U.R.,
Base-catalysed thermal decomposition of terpenoid tosylhydrazones Part III : Chemistry of 12-diazoallisolongifolane/12-methyl-12-diazoalloisolongifolane,
Ind.J. Chem., **25B**, 32 (1986)
25. Vaidya, S.P., Shitole, H.R. and Nayak, U.R.,
Longibornane-7, 8-dione : Reactivity of carbonyl groups via monofunctional derivatives of the diketone,
Ind.J. Chem., **25B**, 36 (1986)
26. Vaidya, S.P. and Nayak, U.R.,
9-Methylenelongibornane : Lewis acid-induced transannalar hydride shift/rearrangement of 9-methyl isolongifolene/1,1,3-trimethyl-7isopropyl tetralin,
Ind.J. Chem., **25B**, 40 (1986)
27. Vaidya, S.P., Suryawanshi, S.N., Jadhav, P.K. and Nayak, U.R.,
Reaction of some longibornane based gamma bromoketones with sodium potassium alloy,
Ind.J. Chem., **25B**, 243 (1986)
28. Roy-Chowdhury, P. and Deuskar, V.D.,
Rheological properties of concentrated polymer solution : Polybutadiene in good and ϕ solvents,
J.Appl. Poly. Sci., **31**, 145 (1986)
29. Roy-Chowdhury, P. and Deshpande, S.B.,
Piezoelectric properties of lead titanate-lead zirconate ceramics modified with the oxides of Cr,Mn,Co and U,
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1. National collection of industrial microorganisms (NCIM) (Infra-1)

i. One thousand and twenty-five cultures were supplied to Industrial and Research establishments and CSIR Laboratories.
ii. One thousand cultures were lyophilized.
iii. Sixty-nine new cultures were added to the collection.
iv. Screening of cultures for the stereoselective conversion of organic compounds was carried out for the organic chemistry division.
v. Screening of auxotrophic and Barbondazine resistant mutants of *Asperigillus niger* for cellulolytic and hemicellulolytic activities was carried out.
vi. Scanning Electron Microscopic (SEM) analysis of the protoplast fusion between *Cellulomonas* and *Bacillus subtilis* or *Zymononas mobilis* was carried out.

2. Centralised chemical analysis and instrumental services (Infra-2)

2.1 Spectro chemical studies (Infra-2(i))

This group provides infrared spectral analysis to the scientists of the laboratory and outside parties. Besides it also undertakes some basic studies on specific compounds. During the year under review, 1691 samples by infrared and 181 by ultraviolet visible were analysed for the laboratory.

NH stretching bonds of N-acetyl (glycine, L-alanine, L-leucine) N' methyl amides in dilute chloroform solution have shown that these dipeptides are present as a mixture of intramolecularly hydrogen bonded five membered ring species and non-hydrogen bonded species. Integrated absorption intensity measurements revealed that the concentration of the intramolecularly hydrogen bonded species decreased from 62% in glycine to 35% in the L-leucine derivatives)

2.2 Physico-chemical analysis (Infra-2(ii))

This group carries out routine classical and instrumental (Spectrography, Spectrophotometry, Flame Absorption spectrophotometry, Polarography, Flame photometry etc.) methods of analysis of samples received from NCL projects as well as from outside parties. It also undertakes development of new methods and improvement of existing methods of chemical analysis, About 2000 samples have been analysed during 1985-86.

2.3 Microanalysis (Infra-2(iii))

This group provides micro analytical services to NCL and outside scientists. In all 4384 analysis were carried out including 397 for outside parties. Microdetermination apparatus (Hexaeuc) Micro-K was received for the micro determination of sulphur and the same was standardised.

2.4 Nuclear magnetic-resonance (NMR) spectrometry (Infra-2(iv))

The group provides NMR spectroscopic help to the scientists and also develops and applies NMR spectroscopy to some of the projects such as Vitamin B_6 and Vitamin E, etc. About 4250 samples were scanned on NMR for various NCL projects. Services were also rendered to outside institutions.

2.5 Mass spectrometry (Infra-2(v))

The group provides mass spectrometry and GC - MS analytical services to NCL and outside scientists. During the period under review.923 samples were analysed by mass spectrometry and 72 by GC-MS technique.

Publications

1. Kulkarni, P.S., Gogte, V.N., Modak, A.S., Sahasrabudhe, S.D. and Tilak B.D,
Chemical ionization induced competing and consecutive heterolytic ring cleavages in the mass spectra of substituted tetrahydro 1,3,2-Oxazaphosphorin-2-oxides,
Org. Mass Spectrom., **20**, 454 (1985)
2. Kulkarni, S.Y., and Pansare, V.S.,
Electron imapct and chemical ionization mass spectra of some tetraacetylated anomeric glycosides.,
Org. Mass Spectrom., **21**, 23 (1986)

2.6 Electron spectroscopy for chemical analysis (ESCA) (Infra-2(vii))

During the reporting period, 360 samples were analysed by ESCA, using various techniques such as XPS, UPS and AES.

In addition to maintaining the analytical facilities, the following basic research works were carried out.

The segregation and oxidation studies on FeZr, CuZr and Zr were completed. XPS studies on PbMnFe was also completed.

XPS studies of hydrogen and nitrogen ion implantation on transition metals were initiated.

Publications

1. Badrinarayanan, S., Mandale, A.B., Date, S.K., and Sinha, A.P.B.,
X-ray photoelectron spectroscopic study of surface oxidation of nickel selinide,
Ind J. Chem., **24A**, 633 (1985)

2. Sayyed, B.A., Chatterjee, A.K., Kanetkar, S.M. Badrinarayanan, S., and Date, S.K.,
Surface characterization of an iron oxide catalyst (ethylbenzene-styrene) : An XPS study,
Proc. Ind. Acad. Sci. (Chem. Sci), **96**, 291 (1985)
3. Deshpande, C.E., Badrinarayanan, S., and Date, S.K.,
Stabilized MnO and its solid solutions $Mn_{1-x}Zn_xO$ (x=0.001 to 0.05) : Thermogravimetric and XPS studies.,
J. Mater. Sci., **4**, 922 (1985)
4. Srivastava, S., Badrinarayanan, S. and Mukhedkar, A.J.,
X-ray photoelectron spectra of metal complexes of substituted 2, 4-Pentanediones.,
Polyhedron, **4**, 409 (1985)
5. Deshpande, C.E., Date, S.K. and Hauser, J.J.,
Spin-glass transition in stabilized $Mn_{1-x}Zn_xO$(9x=0.001),
J. Mater. Sci. Lett., **5** 997 (1986)

2.7 Analytical group of the process development division (Infra-2 (viii))

Major activities of this group are (a) to give analytical support to various projects (b) development of analytical procedures required for the ongoing projects (c) preparation of analytical manuals for the process developed in the division, and (d) basic research in the field of analytical chemistry.

During the period under review the group handled more than 2000 samples from various projects, including samples from industry.

Continuing this research on the development of ion-selective electrods (ICE) new sensors have been developed for Nitrate and Floride ions with improved limits of detection.

Among the new analytical methods developed, a convenient volumetric procedure for the selective determination of N-methyl monochloro aceto acetamide in presence of the dichloro as well as the free amide has been standardised. This iodimetric procedure can be applied as a general procedure for the determination of the monochloro derivatives of active methylene group.

2.8 Analytical group of organic chemistry-I (Infra-2(ix))

The group provides analytical services to the division of organic chemistry-I and other divisions by standard instrumental and classical analytical methods. The group also undertakes assignments for developing and standardising newer analytical methods for organic compounds using GC, HPLC, IR, UV, etc. The group carried out analysis of 2694 samples on IR and 720 samples on GC for NCL projects.

The major area of work during this period was analysis of samples from Bhopal Gas Tragedy (BGT.). New procedures were developed and methods standardised for a variety of samples.

The contribution of this group has been incorporated in the report on BGT published by the CSIR.

Estimation of the active ingredients released from various polymer formulations was carried out with Abate and Fenetrothion as test compounds.

Suitable formulation technique was developed for various grades of polymer incorporated carbofuran prepared by the polymer chemistry division.

Two samples of Neroli and Athena of M/s. Asian Flavour & Fragrance, Bombay, were carried out as per the requirements of customs department.

i. The group is involved in Research & Development work of synthesising new liquid crystalline compounds and studying their application as stationery phases in Gas Chromatography for the separations of closely boiling positional isomers. A new series of liquid crystalline compounds of the type 2-methyl-p-halo-4'-substitued-4-(4''-alkyl benzoyloxy) azobenzenes and 2-methyl-2-halo-4'substituted-4-(4''-substituted cinnamoyloxy) azobenzenes were synthesised and tested for the separations of substituted benzenes and naphthalenes.

ii. A method to correlate structure of a compound and its pesticidal activity was developed using liquid chromatographic techniques. Number of compounds with 1,2,3,4,7, 7-hexachloro-bicyclo (2.2.1) hept-5-ene as the common moiety were synthesised. Their insecticidal activities against mosquito larvae and house-flies were tested. Experiments to correlate activity and chromatographic behaviour were in progress during this period.

Publications

1. Panse, D.G., Bhalerao, N.V., Bapat, B.V., & Ghatge, B.B.,
Application of mono & disubstituted phthalic acid and oxydibenzoic acid polyester phases in gas liquid chromatography,
Ind. J. Chem., 23, 198 (1985)
2. Bhalerao, N.V., Panse, D.G., Bapat, B.V. and Ghate, B.B.,
Synthesis of disubstituted and nitrosubstituted new liquid crystals,
Ind. J. Chem., 24B, 327 (1985)

2.9 NETZSCH Thermal Analyser (Infra-2(x))

During the year under review, thermograms of 250 samples received from NCL scientists working on different projects were received. Thermal decomposition temperatures and phase charges during heating and cooling cycles were studied from thermal analysis data.

DTA technique was used to characterise the influence of preparation conditions of silver carbonate on its thermal decomposition in preparation of silver catalyst.

High temperature oxidation of tin-selenide was studied and it was observed at low temperature

(200°C). The interaction of oxygen with SnSe leads to surface oxidation with the formation of SnO_2, whereas at 410°C SnSe undergoes a phase change. Further heating at high temperature bulk oxidation of SnSe to SnO_2, was observed to take place in two steps. Initially oxoselenide (either SnOSe, or both SnOSe and $SnSeO_2$ mixture) is formed which subsequently reacts with additional oxygen to form SnO_2 as end product.

The samples received from M/s. Demech Co. and M/s. Larsen and Toubro were analysed and the characterization of these samples were studied with a view to optimise their processes.

Publications

1. Srivastava, A., Singh, P., Gunjikar, V.G., and Sinha, A.P.B.,
Study of the thermal decomposition of iron and barium citrates,
Thermochimica Acta, **86**, 77 (1985).
2. Badrinarayanan, S., Mandale, A.B., Gunjikar, V.G., and Sinha, A.P.B.,
Mechanism of high temperature oxidation of tin selenide,
J. Material Science, 21, 3333 (1986).
3. Choudhary, V.R., Pataskar, S.G., and Gunjikar, V.G.,
Influence of preparation conditions of silver carbonate on its thermal decomposition in preparation of silver catalyst,
Proc. Science and Technology Symposium IPCL, Baroda
P.13. Feb. 1985,

2.10 Scanning electron microscope (SEM) and X-ray fluorescence spectrometer (XRF) (Infra-2(xi))

The structural and optical properties of vacuum deposited films of $CuGaSe_2$ at various substrate temperatures were analysed. Stoichiometric films could be obtained at substrate temperatures as low as 450K. Epitaxial growth was observed on single crystal of NaCl substrates at temperature above 500K. The optical transition energies were obtained at 1.68, 1.78 and 1.92 eV.

A record number of 660 samples were analysed from the microstructure, grain and phase boundaries and grain size distribution by SEM. Elemental analysis by electron probe microanalysis were done on 115 samples during the period.

Publications

1. George, C.D., Kapur, M. and Mitra, A.,
Structure and optical properties of $CuGaSe_2$ thin films,
Thin Solid Films, 135, 35 (1985)

2.11 X-ray diffraction studies (Infra-2(xii))

Structural elucidation studies were carried out of key polycrystalline intermediates an end products obtained in various active priority projects like catalysis, polymers, organometallics and co-ordination complexes. Over 1919 such polycrystalline spectra were obtained belonging to NCL scientists, different educational and commercial institutions. The data yielded valuable information on crystallinity, degree of amorphousness, particle size and presence of different phases, etc.

2.12 GLC and HPLC analysis (Infra-2(xiii))

The group provides facilities in gas liquid chromatographic (GLC) and high performance liquid chromatographic (HPLC) analysis to all the divisions of the laboratory. The analytical services rendered during the year were :

HPLC 385 and GLC 1705 samples. Special methods were developed for analytical and preparative HPLC of samples received in connection with the Bhopal gas tragedy, Assay of opium alkaloids from Government Opium and Alkaloid Works, Neemuch, Vinca alkaloids especially Vinblastin and various industrial samples.

2.13 High pressure laboratory (Infra-2(xiv))

The group provided and maintained facilities for carrying out reactions at pressures and temperatures higher than ambient pressures and temperatures and for compressing various gases in the cylinders. It also undertook work on specific projects of the process development division. Facilities were also provided to outside parties on occasion.

During the period under review 164 experiments were carried out for various research and development projects of the laboratory including experimental facilities to three outside parties.

2.14 Mossbauer spectroscopy (Infra-2(xv))

Structural (electronic and magnetic) studies were carried out on key materials obtained in various active priority projects using Fe^{57} mossbauer spectroscopy, such as, ferrites, catalytic conversion of ethylbenzene to styrene over iron oxide catalyst, stabilizatioin of unstable 3d monoxide like $Fe_{1-x}O$ with Al^{3+} and Cr^{3+}. Several publications have appeared in leading journals.

Publications

1. Sayyed, B.A., Gupta, M.P., Date, S.K., Kamble, K.R., Sonsale, A.Y., and Chatterjee, A.K.,
Structural and catalytic studies of promoted iron oxide catalyst used in dehydrogenation fo ethylbenzene to styrene,
Proc. Ind. Acad. Sciences (Chemical), **95**, 285 (1985).
2. Sayyed, B.A., Chatterjee, A.K., Kanetkar, S.M., Date, S.K. and Badrinarayanan, S.,
Surface characterization of iron oxide catalyst (ethylbenzene-styrene) - A XPS study,
Proc. Ind. Acad. Sciences (Chemical), **95**, 291 (1985)

3. Shrotri, J.J., Deshpande, C.E., Date, S.K., and Ogale, S.B., Chemical passivation of unstable FeO - A mossbauer study, *Hyperfine Interactions,* **28**, 733 (1986).
4. Ogale, S.B., Phase, D.M., Patil, P.P., Kanetkar, S.M., Ghaisas, S.V., Bhide, V.G. and Date, S.K., Ion beam mixing at Fe:Al_2O_3 interface : A CEMS study, *Hyperfine Interactions,* **29**, 1193 (1986).

2.15 Magnetic measurements (Infra-2(xvii))

Magnetic susceptibility measurements of forty compounds obtained from various priority projects were carried out both at room temperature as well as between 77-300K. Stabilized B-H hysteresis loop measurements on thirty hard ferrites obtained from various research projects have been carried out at room temperature. MnO:Ni system was studied using various physico-chemical techniques such as magnetic susceptibility, XRD, DTA/DTG, diffused reflectance, IR, etc. All experimental data have been analysed in terms LFSE models.

Publications

1. Bakare, P.P., Deshpande, C.E., Shrotri, J.J., Kuber, M.V., and Date, S.K., Optical, thermal and magnetic properties of stabilized MnO:Ni system, Proc. of IV National seminar on physics of semiconductors and devices, (Eds. J.G. Garg and P.C. Mathur) 4, 273 (1986)

2.16 Cell for assistance to small scale chemical industry (Infra-2(xix))

The normal activities of the Cell is attending to enquiries dealing with the problems of SS sector and maintaining liaison with Government Directorates, nationalised banks and public institutions connected with SS sector were continued. Forty five problems referred to the cell were tackled on general advice basis and two problems on polyester resin and cellulosic products from sized cotton were tackled on a consultancy basis.

Special visits were made to MITCON, MSFC, MIDC, WMDC, Mahratta Chamber and Federation of Association of Small Scale Industries to discuss SS sector problems and arrange get togethers with entrepreneurs.

Work on the preparation of directories on speciality chemicals and project profiles was continued. A comprehensive list of Small Scale manufacturers and Government Departments, public institutions and allied organisations dealing with the SS sector was prepared and correspondence was initiated with them.

2.17 Crystallography (Infra-2(xx))

The determination of structures of a variety of compounds covering Organic, Inorganic, Biological, Organometallic materials has been carried out. Over 30 such structures have been solved and several publications have appeared in leading journals.

The solution of structures (upto 100 atoms) form the computational point of view and from the data acquisition angle are fully computerised. The new, economic and time saving approaches developed for determining structures are now being used by the crystallographic community.

The studies on structure activity correlations in (a) longifolenes - conformation related perfume action and (b) oxazaphosphorins - conformation related drug action have given a clear understanding of environmental dependent correlations and have led to possible design of receptor sites.

Study of intermolecular interactions like hydrogen bonding, charge transfer interactions and drug action in terms of the electron density destributions has been envisaged. A new approach called the 'molecular deformation densities' (M.D.D.'s) has been developed. Efforts to determine directional preferences of non-bonded interactions in organic ''cages'' in terms of experimental deformation densities is being made.

The study of X-ray diffuse scattering caused by elastic distortion centres in crystals is being extended to quasicrystals.

Publications

1. Dhaneshwar, N.N., Tavale, S.S., Guru, Row, T.N. and Bhoon, Y.K., Structure of 2-1,1-(2Phyridyl) ethyldene-3 azabicyclo 3,2,2 nonane-3-3 carbothio-hydrazide and 3-carboseleno hydrazide, *Acta Cryst,* **C41**, 1188, (1985)
2. Dhaneshwar, N.N. Tavale, S.S., and Guru Row, T.N., Structure of 3-benzyl-5-(methoxycarbonylethylthiomethyl) hydantion, $C_{14}H_{16}N_2O_4S$., *Acta Cryst.*, **C41**, 1320 (1985)
3. Dhaneshwar, N.N., Tavale, S.S., and Guru Row, T.N., Structure of 8-benzyl-4-thia-1,8-diazabicyclo (4.3.0) nonane-2, 7,9-trione, *Acta Cryst.*, **C41**, 1528 (1985)
4. Guru Row, T.N., Structure, conformation and charge density studies by X-ray diffraction, *Current Science,* **54**, 332 (1985)
5. Guru Row, T.N., Direct integration of charge densities from X-ray diffraaction, *Current Science,* **54**, 365 (1985)
6. Guru Row, T.N. and Gadre, S.R., A novel approach for the study intermolecular interactions: Molecular deformation densities, Proc. Ind.Acad. Sci. (Chem. Sci.), **95**, 1437 (1985)
7. Dhaneshwar, N.N., Tavale, S.S., and Guru Row, T.N., Structure of 5,5,7,7,8,8-hexachloro-4-methoxy-3-methyl-5,6,7,8 tetrahydro-6-quinolinone, *Acta Cryst.*, **C42**, 78 (1986)
8. Acharya, K.R., Puranik, V.G., Tavale, S.S., and Guru Row, T.N., Structure of 1,2-spirobiindan-1, 3-dione, A key intermediate in the total synthesis of fredericamycin A., *Acta Cryst.*, **C42**, 334 (1986)

9. Gopinathan, S.,Pardhy, S.A. Gopinathan, C., Puranik, V.G., Tavale, S.S., and Guru Row, T.N., Binuclear rhodium complexes of aromatic azines and crystal structure of salicyldizino tetracarbonyl di-rhodium, *Inorg. Chem. Acta,* **111**, 133 (1986).
10. Ayyangar, N.R., Joshi, S.V., Srinivasan, K.V., Puranik, V.G., Tavale, S.S., and Guru Row, T.N., Colour and chemical constitution of 2-aryl phenalin-1-derivative, *Dyes and Pigments,* **1**, 81 (1986)

3. Properties measurement (Infra - 3)

Keeping in view the objectives of the properties measurement group as mentioned in the earlier report, the following several physical, thermodynamic and surface properties of a number of samples required for different projects of NCL were measured during the period under review :

Density and gravity at room temperature (22), Viscosity at room temperature (56), Refractive index at room temperature (28), sp. heat at room temperature (4), Surface tension at different concentrations (28), Electrical conductivity at room temperature (36), Detergency (49), Emulsification (31), Lime soap dispersion (47), pH at room temperatures (2), VLE (isobaric data) (2), Solubilities at different temperatures and solvents (2).

Basic research on heats of mixing of the following binary systems was carried out to understand molecular interactions and hydrogen bond breaking and possible complex formation.

(a) 1:1 complex of (dibutylamine + isobutanol) with n-hexane at 30°
(b) 1:1 complex of (tributylamine + isobutanol) with n-hexane at 30°
(c) Methanol + acetonitrile at 30° in dilute region
(d) Ethanol + acetonitrile at 30° in dilute region

Volume change of mixing of ethylbenzene with chlorobenzene, nitrobenzene, aniline and benzylalcohol were measured at 25° using continuous dilution dialatometer with a view to understand the charge transfer interactions involved in these systems.

Construction of the vapour pressure apparatus for the measurement of vapour pressures of electrolyte solutions at various temperatures and concentrations has been initiated.

Publications

1. Katti, S.S., and Sethi, S.C., Development of new surfactants from renewable resources, *J. Surf. Sci. and Tech.*, **1 (1) 37 (1985)**
2. Chaudhari, S.K. and Katti, S.S., Excess thermodynamic properties of the binary mixtures of ethylene diamine with isomeric butanols, *Proc. Ind. Acad. Sci. (Chem.Sci.),* **95**, (4) 421 (1985)
3. Chaudhari, S.K., and Katti, S.S., Isothermal vapour liquid equilibria for binary mixtures of n-octane with isomeric butanols at 333.15 k. *Proc. Ind. Acad. Sci. (Chem.Sci.),* **95** (5 & 6), 493 (1985)
4. Chaudhari, S.K., and Katti, S.S., Monomolecular films as water evaporation retardants and other applications of monolayer techniques, *Science Reporter,* **23** (1), 15 (1986)

4. ENTOMOLOGY (Infra - 4)

Four major schemes of work have been identified. Overriding theme is development of biorational pest/vector management systems or products. From this stem two major offshoots namely Controlled Release Delivery Systems and Non-conventional Pest Management. Conventional systems consist of varied bioevaluations principally for pesticidal and comprehensive screen of organisms and bioassays for all activities. All undertakings have a firm base in complementary basic research.

In the area of Controlled Resease Technology, the principal effort has been on optimisatioin and product development in respect of the hydrogel abate dispensors developed at NCL. Field trials in semi-polluted natural waters and relatively clean domestic storage water are in different stages of planning execution or repetition. Links are being forged with appropriate public health agencies for actual field exploitation and extension. Development of specialized despensors for use in septic tanks and others employing different microbiocides for portable water purification are also planned.

Comprehensive screening of Indian plants for pest control activity was continued. Fifty plants investigated extensively and fractions from these and other promising species identified earlier were followed up for identification and isolation of active principles. Nearly one hundred synthetic compounds were also examined for several different activities. Promising leads especially in respect of some bioregulatory and behaviour manipulating principles were successfully followed up and further examined in simulated field experiments.

The concept of development of total or enriched extractives or special conglomerates for improving exploitation potential by direct field/microplot assessment was enunciated and initiated into practice with respect to a few chosen plants.

Simulated storage trials with Neemrich-I on stored tubers in country huts has been designed for execution at NCL itself.

Works was initiated on development of need based products such as fly and roach traps and mosquito coils and repellent creams.

Emphasis in basic studies was on development and standardization of procedures for biochemical investiga-

tion involving effects on different processes and constitutents, especially under chemical stress. Nature, bases and scope of normal as well as induced or manipulated behaviour was also studied with the objective of utilization in novel strategies of pest management.

Publications

1. Sharma, R.N., Vartak, H.G., Mitra, R.B., Rao, J.V., Tungikar, V.B., and Gund P.,
Controlled release systems for aquatic larvicides and their role in safer and better mosquito larva control,
International conference on pesticide toxicity, safety and risk assessment, Lucknow, India, p.5 (1985)
2. Sharma, R.N., Mukherjee, S.N., and Deshpande, S.G.,
Safer, easier and cheaper pest management systems : A novel approach
National conference on key pests of agricultural crops, CSA University of agriculture and technology, Kanpur, (1985)
3. Sharma, R.N., Tungikar, V.B. and Joseph, M.,
Towards new approaches for cleaner, safer and scientific pest management,
National symposium on industrial pollution and pesticides in the context of Bhopal gas tragedy, University of Gorakhpur, p. 21 (1985)
4. Sharma, R.N., Nagasampagi, B.A. and Hebbalkar, D.S.
Some selected behavioural manipulation strategies for controlling insects, Proc. national seminar on behavioural and physiological approaches in the management of crop pests.Tamilnadu Agric. Univ., Coimbatore, p. 1 (1985)
5. Patwardhan, S.A., Sharma, R.N., Gund, P., Phadnis, A.P. and Bhaldar, I.,
Diverse biological effects of some new geranyl based diethers on mosquitoes.,
VI Intern. cong. on pesticide chemistry, Ontario, Canada, p.6 (1986)

5. Instrumentation (Infra-5)

During this period, nearly 700 jobs were attended and installations of computerised catatest equipment of inorganic division and extruders from polymer engg. were carried out.

Development of medium pressure liquid chromatograph has been completed and the equipment underwent six months rigorous trials in org.II division.

Work on sponsored project on IR Spectrophotometer, is nearing completion and the microcontrollers are being tested. The trial assembly and testing of IRS 4000 prototype is in progress. The project will be concluded shortly.

6. Division of Technical Services (DTS) (Infra-6)

Planning, monitoring and research coordination, industrial liaison and technology transfer and documentation and market survey, publicity and public relations are the important activities of DTS.
Thus the division was in some way or the other closely associated with all the research divisions and helped them draw up their research programmes.

Planning, monitoring and research coordination

As in the past, the research programmes for the years 1985-86 and 1986-87 were prepared and placed before the Researcch Advisory Committee (RAC) for its ratification at its 11th meeting and also before the Executive Committee (EC).

In this context, a 300 page document was prepared giving details about annual plans 1986-87, project budget revised estimates 1985-86 budget estimates 1986-87 and the Seventh Five Year Plan projections 1985-90.

Three meetings of the Executive Committee were held during the period under reporting. Besides organisation of these meetings, DTS prepared the final proposals for sponsorship, collaborative, grant-in-aid and consultancy projects and placed them before the EC during these meetings.

Close to 1000 inquiries were received from private and government agencies, the parliament, NRDC, CSIR HQs, the sister laboratories and from AGCR/CSIR Audit groups.

Quarterly reports received from the area/project leaders were routinely scrutinized and important data was fed in the Centralized Project File Bank and reports on the progress of the various projects were sent to the Director pointing out any bottlenecks in the implimentation of the projects.

Industrial liaison, technology transfer etc.

NCL's links with industry not only are growing but have become more stronger in recent years, Convinced by the capacity of the NCL to develop technologies big and small and the consultancy services offered by the NCL more and more entrepreneurs are approaching NCL for different kind of help. During the period under review 11 consultancy, 3 sponsorship/grant-in-aid 1 collaborative agreements were executed.

As a part of NCL's assistance to industries who do not have in-house analytical/testing facilities 969 samples were analysed on behalf of 226 parties. The drawing offfice, reprography and photography rendered the required help to the various divisions in the NCL. More than 341 tracings, 56387 xerox copies, 732 photographs, 1017 prints and 617 slides were prepared.

DTS received 291 applications for financial assistance for research scheme. These were scrutinized and sent to the CSIR with all suitable comments. Quarterly and annual reports giving the research utilization data in respect of the laboratory, were sent to the CSIR.

Documentation, market data collection

The activities in this category are related to (i) surveying and indexing of literature on research management; (ii) technoeconomic survey of important projects; (iii) collection of market data on selected projects; (iv) collection of information on current market prices, licences applied for, licences granted etc. and storage of these on cards.

Twelve instalments of the feature ''Surveying the scene from NCL'' were prepared and published in Colourage and three other journals published by Colour Publications Limited, Bombay.

Publicity, public relations, extramural activities, special tasks, etc.

Five issues of the NCL Bulletin, the house journal of the NCL were brought out. Six press releases on the award won by NCL scientists, and other important events were issued. News about staff and important events was sent to the CSIR news regularly.

Information on NCL's acitivities was compiled and sent to the CSIR in the form of monthly summaries to the cabinet.

The DTS organised and successfully conducted the CSIR Junior Research Fellowship Examination held at the PUNE centre in December 1985. About 550 students appeared for the examination.

NCL participated in the Scientists and Entrepreneurs Get-together organised by the Marathwada Tantradnyana Parishad (Mahratwada Technologists Forum) at Latur from 8th to 10th December 1985. The NCL organised a display at the exhibition under the title ''NCL's contribution to Indian Agriculture''. DTS prepared attractive charts for this exhibition which drew instant attraction of the visitors.

More than 2500 visitors were taken round the laboratory including VIPs.

7. Documentation services (Infra-7)

The library houses about 1,03,307 publications consisting of books, periodicals, patents, standards, technical reports etc. During the period under review 563 books, 1513 bound periodicals, 1032 patents and standards, 55 photocopies, microfilms and translations, 5 technical reports and 28 theses were added to the library. 645 periodicals were received in the library out of which 500 were received on payment and remaining 145 on grants and exchange.

Besides the NCL staff, the library facilities are extended to persons from industries, government departments, universities, colleges and other research organisations. During the period 5590 outsiders made use of the library. 14,266 publications were issued to NCL staff and the corporate members. Under the inter-library loan scheme 75 publications were borrowed and 100 were issued to other libraries. About 1,497 current journals were circulated amongst Heads of Divisions for browsing purposes.

Current awareness bulletins on the following topics were compiled and circulated amongst the scientists. Indian Patent Bulletin, Chemical Reactions, Library Bulletin and Biomass Energy.

C.A. selects - S.D.I services prepared by Chemical Abstracts Services, USA were procured on catalysis (Applied and Physical Aspects), fungicides, herbicides, insecticides, solar energy and zeolites. Copies of these selects were prepared and circulated amongst concerned scientists.

The reprographic section supplied 96,615 exposures to NCL scientists free of charge and 17,113 exposures to outside parties on payment.

The NCL library is an Inspection Centre for Indian Patents. During the period 2517 Indian Patents were recieved for the centre.

The library brought out quarterly technical bulletins in the areas of Polymer Sciences, Engineering and Technology, Drugs and Drug Intermediates and Biomass. The bulletin highlights new developments, breakthroughs, statistical information on production, price, export-import etc. and Government policy. The information included in these bulletins are culled out from the literature available in NCL library and are strictly for internal circulation.

During the period under review copies of 63 papers published by NCL scientists were procured and 2852 reprints were distributed to various scientific workers on request.

The binding section of the library completed the binding and repair of 1238 volumes of library books and journals and 500 jobs for other divisions.

The library has established contact with Dialog Information Services Inc. California for conducting computerised on-line searches of data bases available with them. On line searches on 12 topics were conducted during the period under review.

8. Engineering services (Infra-8)

This section looks after maintenance of the laboratory utilities services i.e. electricity, water, compressed air, gas, vacuum and various types of laboratory equipments and machines. It has a very well equipped workshop which has very wide range of facilities in areas of machining, welding, carpentry, plumbing, electrical and refrigeration. The most important activity of this division is to provide its services for design and fabrication of pilot plants and their installation, fabrication of equipment for the laboratory and research purpose. It plays a vital role in assisting scientists in any engineering activity required to per-

form any R&D project.

During the period under review, about 1445 jobs were completed by mechanical section and 1200 by electrical and refrigeration section, of which the following deserves special mention.

Mechanical

1. Revamping of the structure having platforms in three levels. Design, fabrication and erection was carried out entirely by the engineering services at the cost of Rs. 50,000/- approximately.
2. Setting up pilot plant for solar grade silicon. The complete pilot plant was designed with the ideas and help of scientists and fabricated in the workshop. Major fabrication for the project were as under :

i) H_2 CN_2 gas manifold and arrangement of purifying hydrogen.
ii) Double walled S.S. condensors.
iii) Jacketed reflector with cooling water circulation.
iv) Cracking unit with six electrodes.
v) Fabrication of panels for housing various controls.

3. Electrophoresis combs of various specification for biochemistry division. This is an import sustitute.
4. Fabrication of S.S. Reactor for catalysis group of physical chemistry division.
5. Design and fabrication of Membrane ultrafiltration/microfiltration unit for concentration of macromolecules and microbio cells for the bioengineering group.

The following facility was added to workshop : Tungsten Inert Gas Welding-cum-Plasma arc cutting machine has been procured and put into use. This is a sophisticated welding machine performs welding at higher temperature than normal arc welding. While welding a cloud of inert gas is created around the weld puddle to prevent oxidation of metal. Thus high quality welded joints are obtained. Stainless steel sheets can be cut directly by the plasma arc which works very fast and gives clean cuts.

Civil

Besides the regular maintenance of laboratory and colony, this section supervised and completed the construction of 64 nos. of new staff quarters.

9. Glass blowing (Infra-9)

NCL has a well equipped modern glass blowing section with well trained glass blowers who can design and fabricate many types of special glass apparatus. The section looks after the fabrication, maintenance, repairs, and modifications of glass apparatus.

3840 Job cards were completed during the year, and also carried out 2262 repair work, 9888 general fabrication work, 11 high vacuum system, 161 silica units and 105 special apparatus fabrications. In addition, 456 stopcocks and 6717 standard ground glass joints were also made.

The glass blowing section also rendered various services for silica and glass apparatus fabrications as well as glass pipe line jobs to the following outside parties . viz. Bharat Electronics Limited, Pune; Hindustan Organic Chemicals, Rasayani; High Explosive Factory, Pune. Apart from this, the Instructor, Small Scale Industries Institute, Shivajinagar, Pune, was given 2 weeks training in advanced glass blowing techniques.

Some of the jobs that required special skills were the fabrication of silica reactors, BET units, cryostats for the magnetic susceptibility unit, high vacuum units, heat exchangers and micro apparatus.

APPENDIX

1. SERVICES RENDERED TO INDUSTRY, RESEARCH INSTITUTES, UNIVERSITIES ETC.

The laboratory has been extending its assistance, whenever possible, to industry, R&D units, educational institutes and project engineeiring organizations by way of (1) consultancy on project development, trouble shooting and establishment of in-house R&D units; (2) undertaking specified developmental work on sponsored basis; (3) rendering *ad hoc* assistance on industrial problems of standardisation, optimization, analysis, material testing and trouble shooting; (4) associating with project engineers in preparing feasibility reports and making turnkey offers on NCL technologies; (5) collaborating with industry for the development of complex and high-risk technologies of the laboratory on semicommercial scale; and (6) participating in the industry's negotiations for the import of technologies and in their assimilation. The norms and nature of such assistance are as follows :

1.1 Modes of technological assistance to industry by the NCL

1.1.1 Consultancy

Assistance of NCL experts in various branches of chemistry is made available to the chemical industry through consultancy offered by NCL.

1.1.2 Sponsored schemes

Industry can utilise the facilities expertise and infrastructure of the NCL by sponsoring time-bound research and development projects on specific processes and problems. The criteria and terms for undertaking sponsored work at the NCL have been detailed elsewhere in the report.

1.1.3 Ad hoc assistance

NCL can render assistance to industry on exploratory work, standardisation, optimization, feasibility studies, analysis and testing, etc. on payment of *ad hoc* fees depending upon the nature of the problems. Such assistance is usually extended for short periods.

1.1.4 Pilot plant work (Level II data)

NCL can undertake pilot plant studies for collection of Level II data (see 3.1) needed for the establishment of a commercial plant, based on laboratory data either obtained at NCL or available with the party. Such work may be taken up on behalf of the party on either sponsored or *ad hoc* basis.

1.1.5 Designs for commercial plants

Based on the level II data collected in the pilot plant, NCL can undertake to prepare chemical engineering designs for a commercial plant of desired capacity on payment of mutually agreed upon fees.

1.1.6 Assistance to small scale chemical industries

In consultation with various government and financial agencies concerned with the development of small scale chemical industries, the NCL cell for assistance to small scale chemical manufacturers started its activities keeping the following objectives in view :

(a) rendering help/advice/consultancy in solving in-plant technological problems, (b) providing assistance in the assessment of know-how from the technological point of view, (c) assisting in the development of know-how on a short-term sponsorship basis, (d) maintaining a data bank and a liaison with the industry, (e) monitoring the assistance rendered, and, (f) organising short term courses, lectures and seminars for the benefit of small scale manufacturers.

1.1.7 R&D Collaboration with industry

NCL is collaborating with industry on some important projects that are engineering intensive and which involve the development of complex technologies with high investment risks. In such cases based on the developmental work at NCL a proving pilot/semi-commercial plant is set up at the collaborating industry's site. Data obtained on this plant is used in the scale-up and design of the full scale commercial plant.

1.2 Supply of culture

During the year under report 1025 cultures from the National Collection of Industrial Microorganisms were supplied to various institutes.

1.3 Analytical services

A large number of analyses were carried out, on payment, for universities, research institutions, government departments, private parties, etc.

1.	Atomic absorption	35
2.	ESCA	67
3.	Flame photometry	17
4.	GC/MS	65
5.	IR	68

6.	Magnetic susceptibility	20
7.	Microanalysis	397
8.	Netzsch thermal analysis	41
9.	NMR	32
10.	SEM/XRF	135
11.	Spectrographic	12
12.	Spectrometric estimation, inorganic analysis of special nature	13
13.	UV, Vis-spectra	16
14.	VPC/GLC/HPLC	56
15.	X-ray diffraction	135

The total receipts on account of analysis testing carried out during the period amounted to Rs. 1.16 lakhs.

1.4 Training

During the period, 36 representatives of various industries and students from IIT's and Institutes were given training in chemistry of natural products, analytical instruments, molecular biology & genetic engineering technique, plant tissue culture technique, microbiological technique, gel elctrophoresis, chemical engineering, polymer sciences, pilot plant and modern glass blowing etc.

2. SPONSORED AND COLLABORATIVE WORK

2.1 Criteria for undertaking sponsored work and normal terms and conditions

The laboratory welcomes sponsored work if it fits into the following general criteria :

(i) The proposed work is within the scope of the present areas of activity of the NCL and the laboratory has the necessary facilities and expertise to carry out the work, subject to consideration of internal load.

(ii) There is an innovative R&D content in the proposed work.

(iii) The technology to be developed will have sufficient socioeconomic impact after completion.

(iv) The technology to be developed is not repetitive and is not already established indegenously.

(v) The project is of a kind that the sponsor or only a few parties can implement. Technologies of wider interest are usually developed by the laboratory on its own.

Broad terms and conditions for charging expenses and fees for sponsored schemes are as follows :

(i) The sponsor pays for or provides the staff required for the investigation. The expenditure borne by the sponsor is computed at 125% of the total salaries of the NCL scientists working on the scheme.

(ii) The entire expenditure on chemicals and raw materials is borne by the firm.

(iii) Special glass apparatus, equipment, instruments and auxiliaries required for the investigation are supplied by the firm or purchased at their expense. The firm will be free to take back non-consumable items on completion of the investigation.

(iv) A fixed charge of Rs. 18,000/- per scientist per annum is payable towards services, depreciation and incidentals. The charge is payable irrespective of whether the scientist is from the NCL or deputed by the sponsor.

(v) A minimum provision of Rs. 15,000/- per year is made for contingencies, sundry expenses and daily wage labour. The charge will vary according to the nature and scale of work.

(vi) A sum of Rs. 60/- per head per annum is payable by the sponsor on account of medical facilities provided for the staff.

(vii) In addition to the above, a fee is payable by the sponsor as know-how fees for the proposed development which is charged as a percentage of the total expenditure. The percentage of the fee charged depends upon the status of the sponsor. Concessions are given to medium scale and small scale firms in this regard.

(viii) The investigation will be carried out for a period of one year in the first instance. However, if the scheme is extended further the charges payable will be as per the prevailing rates of the sponsorship charges at that time.

(ix) The annual payment for the project is made in two equal instalments in advance, at intervals of six months.

(x) Depending upon the nature of work, laboratory bearers/unskilled workers may also be recruited at the cost of the firm.

(xi) Prior to undertaking work on the scheme, sponsor executes an agreement on a five rupee stamp paper with the NCL/CSIR embodying various terms and conditions of the scheme

2.2 Sponsored projects concluded during 1985-86

	Process 1	Party 2
1.	Chloroquin phosphate	Sudarshan Chemical Industries Ltd., Pune and Standard Organics, Hyderabad

2.	Development of IR materials and detectors	Dept. of Sicence and Technology, New Delhi
3.	Development of IR spectrophotometer for analytical applications	Dept. of Science and Technology, New Delhi
4.	Drag reducers for oil transport	Oil Industry Development Board, New Delhi
5.	Multiplicity and instability in chemically reacting system	Indian National Science Academy (INSA), New Delhi
6.	Synthesis of anti-tumour agents-anthracyclines adriamycene and its analogues	Education and Youth Serivces Department, S&T Cell, Govt. of Maharashtra, Bombay
7.	Synthesis of doxepin and ketoprofen	Pharmaceutical Compnay of India (PCI), Bombay
8.	Toluene disproportionation	Indian Petrochemicals Corpn. Ltd., Vadodara

2.3 Sponsored projects continued during 1985-86

1.	Development of process for dextropropoxyphene HCL and other basic drugs	Centaur Laboratories Pvt. Ltd., Bombay
2.	Exploratory work on preparation of chlorocrysanthamate	National Organic Chemical Industries Ltd., (NOCIL), Bombay
3.	Methylation of morphine to codeine	Govt. of India, Ministry of Finance (Department of Revenue), New Delhi
4.	Rosin derivatives and modified resin	Dujodwala Resins and Terpenes Pvt. Ltd., Bombay
5.	Polymer alloy resins for composites	Dept. of Science and Technology, New Delhi
6.	Polymeric materials based on CNS liquid	Dept. of Science and Technology, New Delhi
7.	Pyrethroid intermediates	NOCIL, Bombay
8.	Sulphochlorinated polyethylene	Delhi Cloth Mills Co. Ltd., New Delhi
9.	Synthesis of various receptor drugs and their intermediates	Chemical Industries and Pharmaceutical Laboratories Ltd. (CIPLA), Bombay
10.	Vitamin E	Chemfab, Madras
11.	Water absorbing polymers	Indian Organic Chemicals Ltd., Bombay

2.4 Sponosred projects newly undertaken during 1985-86

1.	Conservation of plants species-seed biology and tissue culture	Department of Environment (DOE), New Delhi
2.	Continuous chlorination of acetoacetamide	Colour Chem Ltd., Bombay
3.	Development of catalyst and process for monomethylamines from methanol and ammonia	Rashtriya Chemicals and Fertilizers Ltd., Bombay
4.	Development and commercialisation of FCC catalyst	Indian Oil Corporation, Faridabad
5.	Development of controlled release pesticide formulations of quinalphos and disulfoton	Sandoz (India) Ltd., Bombay
6.	Development of DCVC acid chloride - intermediate for cypermethrin	Hindustan Ciba-Geigy Ltd., Bombay
7.	Development of improved catalyst for toluene oxidation to benzaldehyde	Indian Organic Chemicals Ltd., Bombay
8.	Exploratory experiments for hydro-dewaxing and hydroprocessing of petroleum fractions	United Catalysts India Ltd., Bombay
9.	High fructose corn syrup	Indian Organic Chemicals Ltd., Bombay
10.	Oxidation of butenes to methyl ethyl ketones (MEK)	National Organic Chemical Industries Ltd (NOCIL), Bombay
11.	Piperazine	Diamines and Chemicals Ltd, Kalol, Gujarat

12.	Polyphenelene sulphide	Shriram Fibres Ltd., Madras
13.	Studies on carbonylation reaction	Deccan Sugar Institute, Pune

2.5 Collaborative work

Wherever possible and desirable, the laboratory collaborates with industry on industrially important projects that are engineering intensive and involve development of complex technologies with high investment risk.

The terms and conditions for such collaborative work depend upon the type of process that has to be developed. However, in general, the following terms are applicable to collaborative work.

(i) The scale of development will be decided by consultation between the NCL and the collaborating firm.

(ii) Initial time targets will be fixed for the completion of major activities. These would, however, be reviewed periodically in joint meetings with the collaborator taking into account the progress made and the bottlenecks being faced.

(iii) If some work has been carried out at NCL prior to the collaboration the collaborating firm will pay for such inputs.

(iv) For further development work on laboratory/pilot plant scale to be carried out at NCL, the expenses will be worked out by mutual agreement between NCL and the collaborating firm. In certain cases the funding may be done in part or fully by a government agency such as NRDC, DST, etc.

(v) The collaborating firm will put up a large pilot plant/semi-commercial plant at its site. All the expenditure incurred will be borne by the collaborating firm and it will have to make its own arrangements for the fabrication.

(vi) Normally NCL on its own will furnish a process package with basic chemical engineering design data for the semi-commercial plant. In some cases a project engineering firm may be associated in the work. The charges for such designs will depend upon the process and the size of semi-commercial plant to be installed and will be included in the share of the expenses to be borne by the collaborator as under (iv). In case the collaborator is involved in the preparation of the process package, his inputs will be taken into account while deciding the total expenditure payable by him as under (iv).

(vii) NCL scientists will be deputed for assisting in setting up and commissioning the semi-commercial plant. The collaborator will pay for such deputation according to the CSIR norms and will bear all expenses of the scientists on travel, boarding, lodging and local transport.

(viii) The collaborating firm will have to make its own arrangements for the fabrication, setting up and commissioning of the full scale commercial plant (that will be based on the design data collected on the semi-commercial plant). NCL will be associated in this matter on an advisory consultancy basis for which the terms and conditions will be spelled out in a separate agreement between NCL and the collaborator at an appropriate time.

(ix) The collaborating firm will be charged some royalty on the net sales from the semi-commerical plant (if used for commercial production) and the commercial plant.

(x) Within 90 days of the successful comissioning of the semicommercial plant the collaborating firm will have to exercise its option for the commercial exploitation of the process. If the firm does not exercise its option within the said 90 days or after opting for it fails to establish commercial production within a specified period (2-3 years), NCL will be free to release the technology to other parties. In such an eventuality the collaborator will be compensated to the extent of the amount he has paid to NCL for the development of the project.

(xi) The collaborating firm will enjoy a limited exclusivity of about 5 years from the successful operation of the semi-commercial plant or about 3 years from the establishment of regular production on the commercial plant, whichever is earlier. The period of exclusivity would however be reduced or the process will be non-exclusive if it is funded by NRDC, DST or some other government agency. It would also be governed by the rules and regulations of such agencies.

(xii) After the completion of the period of exclusivity NCL will be free to offer the process know-how to other parties. In case collaborating firm fully participates in the transfer of technology, it will equally share premia/royalties received from these other parties. If the process is released to other parties before the expiry of the exclusivity period with the concurrence of the collaborator, the terms and conditions for such releases will be decided by mutual agreement. However, in such cases, if the collaborator does not fully participate in the transfer of technology he will be compensated only to the extent of the expenses paid by him to NCL for the development of the project.

(xiii) Notwithstanding clause (xi), in cases of national importance where Government may direct CSIR/NCL to release the developed technology to a third party in the interest of defence, atomic energy, space research or for prevention of import of foreign technology, CSIR/NCL, in consultation with the collaborator, will be free to release the technology to the said third party. The benefits arising from such releases will be shared by the collaborator in accordance with the provisions of clause (xiii).

(xiv) NCL does not undertake guarantees for collaborative work since such work is carried out in constant association and consultation with the collaborator.

(xv) NCL and the collaborating firm will periodically exchange the information generated on the project by way of reports. They will also periodically hold meetings to review the progress of the project.

(xvi) The collaborator shall provide insurance cover against injury/death to all the staff (other than NCL regular staff) working on the project at NCL, as also to the NCL staff deputed to the firm's site for pilot plant/semi-commerical plant / commercial plant work.

(xviii) The collaborating firm will keep confidential all the data received and generated under the collaborative agreement. NCL will also keep such information confidential subject to clauses (x) to (xiii).

These are the broad terms for undertaking collaborative work at NCL and can be modified to a certain extent depending upon the merits of the case. An agreement on stamp paper is executed between NCL/CSIR and the collaborator, embodying the terms and conditions agreed upon by the two parties.

2.5.1. Collaborative projects in progress during 1985-86

1.	Bioscience engineering	United Nations Development Programme (UNDP) Project
2.	Complex reactions in three phase slurry reactors	University of Erlangen, West Germany
3.	Developmnet of technology for conversion of ethanol to ethylene and its commercialisation	Davy Powergas (India) Ltd., Bombay
4.	Heat Pumps	Saford University, UK
5.	Regular packing development	Engineers India Ltd., New Delhi
6.	Technology transfer, bio-technological evaluation and clonal multiplication of Eucalyptus, Bamboo, and Salvadora	National Bank for Agriculture and Rural Development (NABARD), Bombay
7.	Vapour phase oxidation of ethylene to ethylene oxide/ethylene glycol	Engineers India Ltd., New Delhi

3. TECHNOLOGY TRANSFER

3.1 Levels of transfer

The processes developed at the laboratory are worked out and offered at three levels, depending upon the complexity involved in the process, the engineering content and the material volumes to be handled in an economic unit.

Level I covers chemicals of low volume production and which involve simple reactions/process steps. Here the work is carried out on a less than 5 kg per batch scale and the know-how comprises the process, the analytical methods, and process control tests, the specifications of raw materials, and products, and a list of major equipment with suggestions on sizes and materials of construction.

Level 2 includes chemicals involving complex and engineering-intensive technologies. At this level, in addition to the level I work, pilot plant trials on a scale of 10-100 kg/batch or 2-20 kg/hr are carried out and the chemical engineering design data, including scale-up studies, are collected. The know-how is offered in the form of a process package conforming to shcedule 1A of the American Institute of Chemical Engineers Code.

Level 3 relates to turn-key offers through project engineers with financial guarantees of commercial plant, similar to any other turn-key offer.

3.2 Process released/demonstrated during 1985-86

	Process	Licencee
1.	Butyl titanate	Super Urecoat Industries Ltd., Ahmedabad
2.	Cardamom by tissue culture	(i) A.V. Thomas & Co Madras (ii) Cardamom Board, Cochin (iii) R.B. Thakur & Co., Bombay

3.	Eucalyptus terticornis	A.V. Thomas & Co., Madras
4.	Sodium and potassium ferrocyanides	Hindustan Development Corpn. Ltd., Calcutta

4. CONSULTANCY

Assistance of NCL experts in various branches of chemistry is made available to the chemical industry through consultancy services offered by NCL. Public and private sector firms and small scale chemical industries have been benefitted by such consultancy. The services are made available not only to the firms that have purchased NCL know-how, but also to other established chemical companies. According to the guidelines of the CSIR three types of consultancy are offered : (a) advisory (b) engineering and (c) general technical. Under these services, NCL scientists assist in solving chemical problems, detailed engineering designs, equipment, procurement, process and product improvement, plant modifications, commissioning, technology absorption, etc. on certain fee. Consultancy projects undertaken during the year 1985-86 are :

4.1 Consultancy in progress during 1985-86

	Title	Consultee
1.	General technical advice and assitance concerning polyester fibre manufacturing	Indian Organic Chemicals Ltd., (IOCL), Bombay
2.	General technical consultancy	Hindustan Organic Chemicals Ltd., Rasayani
3.	Advice on polymerization and spinning of polyester fibres with reference to process modification and improvements	Swadeshi Polytex Ltd., Gaziabad.
4.	General technical consultancy	Dujodwala Resins and Terpenes P. Ltd., Bombay
5.	Development of piperazine and other chemicals	Diamines and Chemicals Ltd., Kalol
6.	Modernisation of process and plants of the Govt. Opium and Alkaloids Works, Neemuch and Ghazipur	Govt. of India, Ministry of Finance, (Dept. of Revenue), New Delhi
7.	Advisory consultancy for development of catalysts	Standard Alkali, Bombay
8.	Interpretation of data on physico-chemical characteristics of catalyst	Alchemie Research Centre, Bombay
9.	Advisory conultancy on product development, improvement and diversification.	PEFCO Foundry and Chemicals Ltd., Bombay
10.	Advisory consultancy on computer modelling and simulation	Indian Petrochemicals Corpn. Ltd., Baroda
11.	Production of benzene and p-xylene from valuable side streams and interpretation of data generated.	Indian Petrochemicals Corpn. Ltd., Vadodara
12.	Advisory consultancy on computer simulation for syntehtic fibres	IOCL, Bombay
13.	Advisory consultancy for manufacture of polyester resins	Polyester moulding Co. P. Ltd., Bombay
14.	Cellulosic paper	Tasgaon Vaidnyanik Sheti Seva and Drakshakul P. Ltd., Borgaon, Sangli.
15.	Advisory consultancy on entomology	Alchemie Research Centre Pvt. Ltd., Thane
16.	Advisory consultancy employing heat pumps technology	Air control and Chemical Engg. Co. Ltd., Ahmedabad
17.	Advisory consultancy and establishment of tissue culture laboratory for production of plantlets of E. Globals leading to the development of viable plants for field trials	Tata Tea Ltd., Munnar, Kerala
18.	Advice on analysis and interpretation of analytical results of technical pesticides and to provide general guidance concerning registration of pesticides	Khatav Junkar Ltd., Ahmedabad

19.	Advisory consultancy on R and D work on cardamom using plant tissue culture technique	A.V. Thomas and Co. Madras
20.	Advisory consultancy for offering technical assistance for coating flexible PU foam	Atlas Copco (India) Ltd., Pune
21.	Advisory consultancy for manufacture of CMC and other cellulosic products	Maruco Chemicals Product, Malegaon
22.	Advisory consultancy on heat pump system for wood processing	Arna Wood Industries Pvt. Ltd., Bombay
23.	Advisory consultancy on the heat pump system in commercial dryers	Macneill and Magore Ltd., Bombay
24.	Advisory consultancy on heat pump systems for commercial applications	Unidyne Energy Environmental Systems Pvt. Ltd., Bombay
25.	Advisory consultancy on moulding of switch gear components of phenol resins	Larsen and Tubro Ltd., Bombay
26.	Advisory consultancy for trouble shooting and solving the problems of sodium and potassium ferrocyanide plants set up by the company.	Hindusthan Development Corpn. Ltd., Calcutta

5. PREMIA AND ROYALTIES RECEIVED BY NRDC THROUGH NCL PROCESSES DURING 1985-86
(As on December 1985)

	Process	Firm	Premium received (Rs.)	Royalties received (Rs.)
1.	Can sealing composition based on Nitrile Rubber	Arya Chemical Works, Caluctta	—	4,774.75
2.	Dimethoate	Shaw Wallace and Company, Calcutta	—	1,72,980.99
3.	DC Recording polarograph	Chromatography and Instrument Company, Baroda	—	1,005.00
4.	Ethion	Shaw Wallace and Company, Calcutta	—	1,13,755.15
5.	Ethylenediamine	Diamines & Chemicals Ltd., Kalol	50,000.00	42,191.04
6.	Polyurethane coating	Cipy Chemicals, Pune	—	1,360.10
7.	Polyurethane printing rollers	Sree Saraswati Press Ltd., Calcutta	—	8,356.65
8	Quinapyramine sulphate and chloride	Chintamani Fine Chemicals, Pune	—	948.00
9	Theophylline, aminophylline and caffeine	PEFCO Foundaries and Chemicals, Bombay	25,000.00	10,000.00

6. LECTURES AND SEMINARS

6.1 The following visiting scientists delivered lectures in the laboratory

	Scientist	Subject
1.	Prof. T.R. Anantharaman, Programme Coordinator Culture of Advanced study in Metallurgy and Director, Institute of Technology, BHU, Varanasi	Metallic glasses - A new species of engineering materials
2.	Dr. L. Barroilhet, Nicolet Instruments Corpn. USA	FT-IR instrumentation and its applications
3.	Prof. M. Biswas, Dept. of Chemistry, Indian Instt. of Technology, Kharagpur	Recent research work in polymer modification
4.	Prof. T.S. Cameran, Dalhousie University, Halifax, Canada	Sea shells to ceramics - A structural journey
5.	Prof. P.B. Deshpande, University of Louisville, USA	Model predietive control of multivariable processes
6.	Dr. V.V. Gokhale, Eastmen Kodak Company, 1669, Lake Ave, Rochester, New York, USA	Multi-layer coating in the photographic industry
7.	Prof. Govindjee, Chairman, Dept. of Biophysics and Plant Biology, University of Illinois, USA	Recent advances in photosynthesis systems
8.	Prof. J.M. Hanig, Dept. of Chemistry, Purdue University, West Lafayette, USA	Crystal growth and characterisation of Fe_3O_4
9.	Prof. B. Hopefenberg, Dept. of Chemical Engineering, North California State University, USA	(i) A generalised theory describing transport in polymeric membranes above and below the glass transition temperature (ii) The relationship between transportation and physical aging of glassy polymers (iii) State-of-the-art of controlled release technology
10.	Prof. J. Ivin, Professor of Physical Chemistry, Queen University, Belfast	Mechanism of ring opening polymerisation of cycloalkenes by metatheses catalysts

11.	Dr. Jan Hes, Application specialist, Dianex Corporation, USA	Recent developments in ion chromatography
12.	Dr. J.G. Joshi, Dept. of Biochemistry, University of Tennessee, Knoxville, USA	Ferritin - A multifunctional molecule
13.	Prof. A.A. Kadushin, Institute of Chemical Physics of the USSR Academy of Sciences, Moscow	IR spectroscopy in catalysis conditions
14.	Mr. V.A. Koptyug, Vice President, Siberian Division, USSR Academy of Science, Moscow	Some aspects of computer application in organic chemistry (structure elucidation, reaction path recognition, etc.)
15.	Dr. K. Krishnan, Digital Division, BIO - RAD, Cambridge Mass, USA	FT - IR : Recent developments and applications
16.	Prof. V.I. Nefedev, USSR Academy of Sciences, Moscow	ESCA Surface - investigation of solids
17.	Dr. R.C. Pande, Visiting Professor, The State University of New Jersey, USA	Biosynthesis and 13C NMR in structural studies of the antibiotic crisamicin A
18.	Prof. R. Parthasarathy, Rosewell Park Memmorial Instt., Buffalo, New York, USA	From crystallography to chemical physics
19.	Prof. J.M. Pawli Kowski, Institute of Physics, Wroclaw, Poland	$Zn_3 P_2$ solar cell applications
20.	Prof. C.L. Pritchard, Dept. of Chemical Engineering, Edinburgh University, UK	A microcomputers - based data acquisition and control system for heat pump research
21.	Dr. O. Schieder, Mexplank Instt., West Germany	Genetic manipulation using protoplast fusion

22.	Prof. K.P. Sinha, Chairman, Centre for Theoretical Studies, Indian Instt. of Sciences, Bangalore	Structural transition and super-conductivity in some tungsten bronzes
23.	Dr. (Miss) R. Usha, Dept. of Organic Chemistry Indian Instt. of Science, Bangalore	Macromolecular crystallography structures of proteins and viruses
24.	Prof. M.T. Vala, University of Florida, USA	Magnetic circular and linear dichroism spectroscopy

6.2 The following NCL scientists delivered lectures at various institutes, college courses, etc.

	Scientist	Subject	Venue
1.	Mr. N. Amarnath	Controlled release of aquatic herbicides	Livestock Insert Lab. U.S.D.A. Beltsville Maryland
2.	Dr. K.V. Krishnamurthy	Protoplast technology for genetic engineering	NBTB short term training course on Plant Molecular Biology NCL, Pune
3.	Dr. A.F. Mascarenhas	(i) Plant tissue culture: some applications	NBTB short term training course on Plant Molecular Biology, NCL, Pune
		(ii) Plant tissue culture : A prospective consumer oriented technology	International Workshop on Molecular Bio-sciences and bio-technology organised by SPIC, Madras
		(iii) Plant tissue culture : A rapidly growing technology	A Workshop on technology park at University of Poona
		(iv) Applications of plant tissue culture : Possibilities, advantages and limitations	College of Agricultural Banking, Pune
4.	Dr. R.S. Nadgauda	Plant tissue culture : Cardamom	Regional Research Laboratory, Trivandrum
5.	Dr. S.K. Rawal	Synthesis and transport of proteins into chloroplast small sub units of ribulose biphosphate carboxylase. A case study	MBTB short term training course on plant molecular Biology, NCL, Pune

6.3 Seminars/Workshops/Special training courses, etc. organised by/at NCL

1. **Plant Molecular Biology Workshop**
   A workshop on Plant Molecular Biology, sponsored by the National Biotechnology Board, New Delhi, was held at the NCL from the 10th to 30th June 1985. There were 17 participants from all over the country. All the lectures and experiments were designed to train them in basic as well as modern methods in plant molecular biology.

2. **Workshop on Heat Pumps**
   A short course and workshop on heat pumps and energy conservation was organised in NCL jointly by NCL and University of Salford, U.K, on 2nd and 3rd December 1985. About 45 participants from process industries, equipment manufacturers project engineering companies and energy consultants attended the course.

7. STAFF STRENGTH (as on 31.3.86)

1.	Scientific		
	(i)	Director	1
	(ii)	Scientist in Director's grade	2
	(iii)	Dy. Director/ Scientist 'F'	5
	(iv)	Scientist 'E-II'	16
	(v)	Scientist 'E-I'	57
	(vi)	Scientist 'C'	83
	vii)	Scientist 'B'	176
	(viii)	Scientist 'A'	20
	(ix)	S.S.A.	45
	(x)	Scientific Assistant	36
	(xi)	S.L.A. ** Grade VII	9
		Total	450
2.	Technical		276
3.	Administrative		157
4.	Group D (Tenchnical) (Including Trade Apprentices)		172
5.	Group D (Non-Technical)		56
		Total	1111
6.	Research Fellows, Pool Officers and Guest Workers		
	(i)	JRFs, SRFs and PDFs	57
	(ii)	CSIR Pool Officers	5
	(iii)	Guest Workers	3
	(iv)	Research Associates	2
		Total	67
7.	Scientific staff appointed for sponsored projects, schemes.		42

** Senior Laboratory Assistants (SLAs) are included in the scientific category since a majority of them have post graduate qualifications and are engaged in scientific work.

8. STAFF NEWS

8.1 Awards/Honours

1. ICMA Award to NCL

The Indian Chemical Manufacturers Association (ICMA) has recognised the contributions of National Chemical Laboratory (NCL), Pune, in conferring special citations - for the Encilite-1 catalyst system developed for the isomerization of xylenes and the process for ethylenediamine (EDA) and polyamines. Encilite-1 catalyst is now being employed at IPCL for the commercial production of para and ortho xylenes from a feedstock rich in ethylbenzene was the result of the joint efforts of NCL, ACC and IPCL into this frontier high-tech area of a World class compliment in the joint endeavours. The smooth commercialization of EDA technology is the successful transfer of technology to the Diamines and Chemicals Limited, Kalol that culminated in the development of the technology.

2. Dr. L.K. Doraiswamy, has been invited by the University of Salford, UK, to take up the appointment of Visiting Professor for a further period of one year from 1st August 1985.

3. Dr. L.K. Doraiswamy, has been invited to deliver the Rajamata B.D. Amine memorial lecture for the year 1983 - by ICMA, Bombay.

4. Dr. S. Devotta, has been awarded an honorary visiting fellowship in the Department of Chemical and Gas Engineering, University of Salford, UK

5. Dr. A. Dutta, has been awarded Science Academy Medal for Young Scientists for the year 1985 by the Indian National Science Academy, New Delhi for his significant contributions in the area of macromolecular hydrodynamics in general.

6. Dr. S.K. Date, has been invited by the University of Poona, Department of Chemistry to be an Honorary Visting Professor.

7. Dr. S.K. Date, has been selected in a special citation list of 240 scientists who have published 30 or more papers on Mossbauer Specroscopy, prepared by Mossbauer Effect Reference and Data Journal to mark the 25th anniversary of the Mossbauer Effect.

8. Dr. M.G. Kulkarni, has been invited by DST to prepare a state of the art report on separations by membranes.

9. Dr. R.A. Mashelkar, has been appointed Honorary Visting Professor at the University of Salford, UK for the academic year 1985-86.

10. Dr. R.A. Mashelkar, has been awarded the UGC National Lectureship in Engineering and Technology for the year 1985.

11. Dr. R.A. Mashelkar, has been elected as a Fellow of Maharashtra Academy of Sciences in 1985.

12. Dr. R.A. Mashelkar, received the UDCT Golden Jubilee Medal for being selected as one of the twenty outstanding pesonalities who have been associated with UDCT over the past fifty years.

13. Dr. R.A. Mashelkar, has been interviewed by UK Institution of Chemical Engineers and his interview has been published in the issue of Chemical Engineer (London) as ''The Chemical Engineer profile with Dr. R.A. Mashelkar''. Dr. R.A. Mashelkar is the first Chemical Engineer outside UK to have had this honour of figuring in the prestigious ICE profiles of the Chemical Engineer (London).

14. Dr. R.A. Mashelkar, has also been appointed as Visiting Fellow at the UDCT, University of Bombay.

15. Dr. V.M. Nadkarni, has been elected as a fellow of Maharashtra Academy of Sciences in 1985.

16. Dr. V.M. Nadkarni, has been appointed as Visiting Professor, at Department of Physics and Chemistry, University of Poona.

17. Dr. Paul Ratnasamy, has been awarded the prestigious 'Shanti Swarup Bhatnagar Prize' in the engineering sciences for the year 1984.

18. Dr. Paul Ratnasamy, has been named as one of the winners of the coveted Vasvik Awards for 1982, for excellence in Chemical Science. The award consists of a gold medal, a citation and Rs. 25,000/- in cash.

19. Dr. P.K. Ranjekar, was awarded DBT Associateship for one year to work at Indiana University, USA during the year 1985-1986.

20. Dr. S.K. Rawal, has been offered a National Biotechnology Board Overseas Junior Associateship for excellence in the area of Bio-technology to work at University of Arizona, TUCSON, USA for three years.

21. Dr. A.V. Shenoy, has been selected as young Associate by the Indian Academy of Sciences, Bangalore, for his contributions in the field of Polymer Science and Engineering.

22. Pune Municipal Corporation (PMC) Honours NCL Scientists. PMC honoured Dr. M.G. Kulkarni, Dr. S.D. Prasad and Dr. J.S. Yadav on the Republic Day for their significant contribution to the growth of science in Pune. They were presented with a pleque to mark the occasion at the Shivaji Sabhagraha. All the three recepients of this honour are Young Associates of the Indian Academy of Sciences.

23. Drs. R.B. Mitra, S.M. Abhyankar, B.B. Ghatge, D.G. Panse, S. Ghosh, Mr. M.B. Unde and Mr. Nand Kishore have jointly been awarded the NRDC award for the year 1986 for successful development of the process for the manufacture of Ethion, a useful pesticide.

8.2 Deputations / visits abroad

1. Mr. G.M. Chaphekar, was deputed for advance study to West Germany under GAES-(DAAD) exchange programme. (June 84 to September 1985).

2. Mr. M.B. Unde, Mr. Ishwar Chandra, Mr. D.V. Paranjape and Mr. S.K. Chaudhary were deputed to UK for advance training in the field of heat pumps - heat energy recovery under NCL-Salford University link programme (June 1984 to September 1985).

3. Mr. P.G. Shukla, was deputed to USA to avail UNIDO training fellowship in the field of controlled release technology under UNDP project on Bioscience and Engineering (six months from December, 1984).

4. Mr. N. Amarnath, was deputed to USA to avail UNIDO taining fellowship in the field of controlled release technology under UNDP project on Bioscience and Engineering (Six months from March, 1985).

5. Dr. N.R. Ayyangar, was deputed to USA to study the latest developments in the area of organoboranes, synthetic organic chemistry and analytical methods etc. under CSIR-CNRS exchange programme, (Five weeks from March 1985).

6. Mr. K.B. Bastawade, was deputed to USA to avail UNIDO training fellowship in the area of cellulose, biotechnology under UNDP project on Bioscience and Engineering, (Six months from April 1985).

7. Mr. D.V. Gokhale, and Miss Rita Verma were deputed to UK to avail UNIDO training fellowship in the fields of microbial genetics, bio-utilization of cellulosic wastes and applied Microbiology/ Biotechnology and Engineering, (Six months from April 1985).

8. Mrs. A.V. Pundle, was deputed to West Germany to avail training in the field of Biotechnology/Immobilized microbial whole cells technology etc. under UNDP project on Bioscience and Engineering (Six months from April 1985).

9. Dr. Harish Narain, was deputed to USA to avail UNDP training fellowship in the field of controlled release technology and pesticide systems under UNDP project on Bioscience and Engineering (Nine months from May 1985).

10. Dr. R.A. Mashelkar, visited UK to discuss the collaborative programme on Heat pumps with University of Salford, UK under NCL/CSIR-Salford University link programme (Two weeks in May 1985).

11. Dr. P.K. Ranjekar, was deputed to USA to avail NBTB Junior fellowship to work in one of the leading laboratories at USA and also visit other laboratories under NBTB overseas associateship (One year from August 1985).

12. Dr. Rajiv Kumar, was deputed to West Germany for study/training under GAES (DAAD) exchange programme (Two years from June 1985).

13. Dr. L.K. Doraiswamy, visited UK to have bilateral discussion with leading catalysts manufacturers, users and project engineers on the Encilite and other catalysts developed at the laboratory under NCL/CSIR-Salford University link programme. (Two weeks in June 1985).

14. Dr. V.G. Naik, was deputed to USA to avail training in HPLC equipment sponsored by Water Associates Ins., USA (Three weeks in August 1985).

15. Mr. V.R. Joshi, was deputed to USA to avail advanced training in HPLC equipment sponsored by Water Associates Ins., USA (Three weeks in September 1985).

16. Mr. B.G. Gaikwad, was deputed to USA to avail UNIDO training fellowship in the field of applied microbiology of cellulose utilisation under UNDP-project on Bioscience and Engineering, (Six months from September 1985).

17. Dr. V.G. Neurgaonkar, was deputed to West Germany to study/training in the area of ultra pure silicon under DAAD programme (Three months from October, 1985).

18. Dr. K.V. Krishnamurthy, was deputed to USSR for organising and participating in S and T exhibition of India held at Moscow (during September 1985).

19. Dr. L.K. Doraiswamy, visited USSR to visit various institutes in the area of Heat and Mass Transfer, Catalysts, Inst. of Fossil Fuels and also delivered lectures and visited S and T Exhibition at Moscow (Three weeks in September, 1985).

20. Dr. Paul Ratnasamy, visited Chile to deliver lectures in heterogeneous catalysts under UNESCO CHI-84/005 and the University of Chile programme (Two weeks in September-October 1985).

21. Mr. R. Jagannathan and Mr. K.R. Patil were deputed to UK to avail training in Heat pumps and heat energy recycling under NCL/CSIR-University of Salford link programme (One year from October 1985).

22. Dr. S.G. Hegde, was deputed to USSR to study in the area of catalysis under Indo-USSR cooperation in S&T programme, (Three months from October 1985).

23. Dr. S. Devotta, was deputed to UK to avial training in Heat pumps and heat energy recycling under NCL/CSIR - University of Salford link programme (Three weeks from October, 1985).

24. Mr. S.R. Bhide, was deputed to USA to avail advanced training in liquid chromatography sponsored by M/s Millipore Waters Chromatography, USA (Three weeks in October, 1985).

25. Mr. G. Venugopalan, was deputed to USA to avail fellowship training in the field of instrumentation and microcomputer under UNDP project on Bioscience and Engineering (Three months from November 1985).

26. Dr. A.J. Verma, was deputed to France to study in the areas of membrane sciences of semipermiable membranes and analysis of the characteristics of various polymers under CSIR-CNRS exchange programme (One week in February 1986).

27. Mr. R.S. Singh, was deputed to UK to study the functioning of library and information centres in UK and to gain working knowledge of modern technology and equipment in handling and disseminating scientific and technical information under CSIR-British Council visitorship programme (Three weeks in March 1986).

28. Dr. J. Barnabas, visited Japan to familiarise with modern research approaches in macromolecular under short-term exchange programme of INSA-JSPS (Two weeks in February 1986).

29. Dr. C.P. Joshi, was deputed to West Germany to avail advanced study in the area of genetic modification of plants using protoplasts under GAES-DAAD programme (From June 1983 to September 1985).

8.3 Participation of NCL Scientists in symposia, seminars, etc.

	Seminars/Symposium/Conference	Scientists
1.	INSA Golden Jubilee celebration seminar on physics and chemistry of surfaces, New Delhi	Dr. S.K. Date Dr. S. Badrinarayanan Dr. A.B. Mandale Dr. S.D. Sathaye
2.	Seminar on Electrochemical analysis and photoacoustee spectroscopy, Institute of Engineers, Pune	Dr. C.E. Deshpande Dr. S.K. Date
3.	Third national symposium on Mass spectrometry, RRL, Hyderabad	Dr. P.S. Kulkarni Mr. S.P. Mirajkar
4.	Second national seminar on X-ray spectroscopy and related areas, Nagpur University, Nagpur	Dr. S.K. Date Dr. C.E. Deshpande
5.	Second national symposium of the Indian Society for composite materials, Bhopal	Dr. S.N. Kashirsagar
6.	Indo-Soviet symposium on electronic materials, University of Poona, Pune	Dr. M.S. Setty Dr. V.J. Rao
7.	Seminar-cum-workshop on NMR spectroscopy, P.G. School for Biological Studies, Ahmednagar	Mr. K.G. Deshpande
8.	Seminar on biology on fungi, University of Poona, Pune	Dr. M.C. Srinivasan Mr. S.G. Patil
9.	Scientific meeting of the Association of Mircrobiologists of India (Poona Unit), University of Poona, Pune	Dr. M.V. Deshpande
10.	Thick film hybrid circuit, technical seminar-cum-exhibition at IISc, Bangalore	Dr. M.S. Setty
11.	Seminar on cellulases : Mode of action and substitute specificity, Bombay	Dr. A.H. Lachke
12.	XVII National seminar on crystallography, IIT, Madras	Dr. T.N. Guru Row Dr. (Mrs.) V.G. Puranik
13.	Workshop on patent procedures and related matters, NPL, New Delhi	Mr. S.S. Joshi Dr. R.J. Lahoti
14.	Training programme on technology information systems, NRDC, New Delhi	Mr. R.R. Hirwani Mr. C.U. Saraf Mr. M.D. Bauskar
15.	Training programme on technology transfer and management, NRDC, New Delhi	Dr. V.K. Jinaraj
16.	11th Plant tissue culture conference, Hyderabad	Dr. K.V. Krishnamurthy Mr. D.A. Godbole Dr. C.P. Joshi
17.	Course on computer applications in information science, University of Poona, Pune	Mr. M.B. Patil Mr. V.G. Deodhar
18.	Indo-UK training course for Asian countries on biodegradation and management of culture collection of microorganisms, IARI, New Delhi	Mr. I.I. Sutar
19.	55th Annual general body meeting of SBC India, Trivandrum	Mr. J.M. Khire
20.	DBT sponosred training workshop on modern techniques in recombinant DNA technology, Jawaharlal Nehru University, New Delhi	Ms. Madhavi Dabak

21.	Workshop on technology park, University of Poona, Pune	Dr. A.F. Mascarenhas
22.	Cardamom day organised by RRL, Trivandrum	Dr. R.S. Nadgauda
23	Seminar on library automation and information retrieval : Challenges and opportunities, II Sc., Bangalore	Mr. R.S. Singh
24.	26th Annual conference of Association of Microbiologists of India at University of Madras, Madras	Dr. M.V. Deshpande
25.	National seminar on bioenergy information sources, New Delhi	Mr. M.C. Srinivasan
26.	38th Annual IIChE meeting, Calcutta	Dr. A. Dutta
27.	National conference on key pests of agricultural crops, Kanpur	Dr. R.N. Sharma Mr. S.N. Mukerjee
28.	Third national symposium on mass spectrometry, research applications and instrumentation, RRL, Hyderabad	Dr. P.S. Kulkarni Mr. S.P. Mirajkar
29.	54th Annual meeting of the society of Biological Chemists (India), Pantnagar (Nainital)	Dr. J.B. Barnabas Dr. (Miss) R. Seeta Mrs. S.S. Deshmukh Mr. H. Balakrishnan Dr. R. Tewari
30.	World congress for the synthesis of science and religion, Bombay	Dr. M.C. Srinivasan
31.	Third national symposium on mass spectrometry, research applications and instrumentation, as observers, RRL, Hyderabad	Dr. J.S. Yadav Dr. V.H. Deshpande Dr. (Mrs.) Bhanu Chanda Dr. M.K. Gujar Dr. S.K. Sharma
32.	Annual meeting of Deccan Sugar Technologies Association, Pune	Mr. J.V. Rajan Dr. N.R. Ayyangar
33.	Course on computer application in information sciences	Mr. M.B. Patil Mr. V.G. Deodhar
34.	National symposium on insect physiology, ecology and behaviour, Trivandrum	Dr. R.N. Sharma Mr. S.N. Mukherjee Mr. P.H. Vartak Mr. S.G. Deshpande

35.	Second national symposium on surfactants emulsions and biocolloids, IIT, Delhi	Dr. S.S. Katti
36.	Seminar on animal interaction Botanical Survey of India, Pune	Dr. R.N. Sharma
37.	Training course on genetic manipulation of plant protoplasts, New Delhi	Mr. D.A. Godbole
38.	National symposium on industrial pollution and pesticides, Gorakhpur	Dr. R.N. Sharma Mr. V.B. Tungikar
39.	Mahabaleshwar symposium on transposable genetic elements, Mahabaleshwar	Dr. (Mrs.) Vidya S. Gupta
40.	National conference on theoretical chemistry and spectroscopy, University College of Science and Technology, Calcutta	Dr. R. Tewari
41.	Workshop on All India coordinated research project on White Grub, Mahatma Phule Agricultural University, Rahuri, Kolhapur	Mr. P.G. Shukla
42.	Third national workshop on catalysis and catalysts in chemical industries, Bhubaneshwar	Dr. V.P. Shiralkar Dr. A.N. Kotasthane Dr. P.A. Awasarkar Mr. S.R. Padalkar Mr. K.J. Waghmare
43.	National symposium on yeast technology, Hissar	Mr. S.G. Patil
44.	Guha research conference, Pachmari	Dr. J. Barnabas Dr. A.F. Mascaranhas
45.	International winter school on direct methods, macromolecular crystallography, University of Madras, Madras	Dr. (Mrs.) V.G. Puranik
46.	Meeting of the study group constituted for development of a suitable stores and purchase manual, CSIR, New Delhi	Mr. Thomas Joseph
47.	International seminar on frontier areas, RRL, Jorhat	Dr. S.N. Shintre
48.	All India symposium on recent advances in studies of plant products, Sagar	Dr. U.R. Kalkote
49.	XI Annual conference on environmental mutagens and carcinogens, Madras	Dr. (Mrs.) S.R. Thengane
50.	XI IASLIC Conference, 1985, Bangalore	Mr. M.D. Panse

51.	Workshop-cum-seminar on actionomyceles, M.S. University, Baroda and Alembic Chemical Works Co. Ltd., Baroda	Dr. M.C. Srinivasan Mr; J.M. Khire
52.	IMTEX-86 at Bombay	Dr. P.G. Sharma Mr. V.K. Shelot Mr. K.M. Inamdar Mr. K.Y. Shinde Mr. D.B. Pradhan Mr. S.T. Kshirsagar Mr. A. Anandraj Mr. R.P. Purandare
53.	Workshop on operating experience with FCC Units and strategies for optimization, Dehra Dun	Dr. S. Sivasankar
54.	Conference on industrial fire hazards their prevention and control, Institute of Energy Management, Bombay	Mr. K.M. Inamdar
55.	International conference on pesticides toxicity, safety and risk assessment, ITRC, Lucknow	Dr. R.N. Sharma Dr. J.V. Rao
56.	Second international symposium on mango, Bangalore	Mr. A.L. Nadgir Mr. M.M. Jana
57.	Seminar on computers in chemical industry process simulation and control, IIChE, Bombay	Dr. S.N. Shintre Mr. D.D. Ravetkar
58.	NBTB short term training course on Gene Cloning, BHU, Varanasi	Dr. (Mrs.) V.V. Deshpande
59.	Seminar on energy conservation in process industries, Institution of Engineers (India), Roorkee Local Centre	Mr. D.D. Ravetkar Dr. A. Bhattacharya
60.	Seminar on water treatment, Institution of Engineers, Pune	Dr. S.N. Shintre Dr. M.G. Parande Mr. D.D. Ravetkar Mr. S. Ghosh Mr. S. Gopichand Mr. S.N. Balsubramanian
61.	Course on zerobase budgeting and associated management accounting concepts, NITIE, Bombay	Mr. M.D. Bauskar
62.	National symposium on modelling and simulation in chemical engineering, Bangalore	Dr. V.S. Patwardhan Dr. R.V. Choudhary Dr. B.D. Kulkarni Dr. A. Bhattacharya Dr. Anit Dutta
63.	International workshop on molecular bioscience and biotechnology, Madras	Dr. A.F. Mascarenhas

8.4 Plenary lectures/key-note addresses/invited lectures given by NCL scientists

	Scientist	Subject
1.	Dr. N.R. Ayyangar	Invited lecture on dyes and dyestuff industry in the Academic Forum lecture series of the University of Poona, Pune (September, 1985)
2.	Dr. L.K. Doraiswamy	(i) The Rajmata B.D. Amin Memorial Lecture for the year 1985 The Indian Chemical Industry in 2000 A.D. (August 1985) (ii) Valedictory address on the termination of training programmes at IAT, Pune Engineering Education in India' (December, 1985) (iii) Lecture on the R&D in the dyestuff industry for the 2000 ADs as a Chief Guest at the Annual General Meeting of the Dyestuffs Manufacturers Assocation of India, Bombay (March 1986) (iv) A Key-note address on recent advances in gas-solid catalytic reactors at the International seminar on frontier areas in applied chemical and engineering sciences (ISOFA-1), RRL Jorhat (March 1986)
3.	Dr. T.N. Guru Row	Invited lecture on Novel methods to solve difficult structures using Mutan package at the XVII National Seminar on Crystallography, IIT Madras (December 1985)
4.	Dr. K.V. Krishnamurthy	Invited lecture on genetic modification of plants through protoplast technology at NINTH All India Cell Biology Conference held at University of Poona, Pune (January 1986)
5.	Dr. R.A. Mashelkar	(i) Invited lecture on Role of modelling and simulation in Indian R&D, IISc, Bangalore (August 1985) (ii) Migrating macromolecules INSA meeting, TIFR, Bombay (May 1985) (iii) Macromolecular migration : Causes and consequences, Dept. of Chem. Engg., Edinburgh University, U.K. and at Unilever Research Centre, Port Sunlight, UK (May 1985)
6.	Dr. M.S. Setty	Invited lectures at University of Poona, Pune : (i) Thick film pastes and their applications (September 1985) (ii) Thick film conductors and resistors - Effect of the process parameters on their properties (September 1985)

8.5 Membership of Committees

The following staff members were nominated to serve on various committees, boards, etc. as indicated

	Scientist	Capacity	Name of the Committee
1.	Dr. S.M. Abhyankar	Member	Board of Studies in Chemical Engineering, Small Scale Industries Services Institute, Bombay
2.	Dr. N.R. Ayyangar	Member	Expert Group of Drugs for Safety in Chemicals and Petrochemical Industries
		Member	Expert Group on Chemicals for Safety Survey Committee. Expert group II–Private Sector Chemical Unit formed by Ministry of Industry, Govt. of India (1986)

3. Dr. J. Barnabas	Member	Science Advisory Committee to the Cabinet (SACC) 1983-85
	Member	Council of Indian National Science Academy 1984-86
	Founder Member & Fellow	Maharashtra Academy of Sciences
	Member	Guha Research Conference
	Member	Sectional Committee on General Biology, Indian Academy of Sciences, since 1983
	Member	Executive Committee of MACS, Pune, since 1983
	Member	Editorial Board of the Indian Journal of Biochemistry and Biophysics, since 1980
	Member	Editorial Board for Proceedings of Indian Academy of Sciences - Animal Sciences and Biological Sciences
	Member	Editorial Board of Biology Education
4. Dr. V.R. Choudhary	Member	Board of Studies in Chemical Technology, Faculty of Nagpur University, Nagpur
5. Dr. S. Devotta	Member	Editorial Board of the Journal of Heat Recovery Systems, Pergamon, UK
6. Dr. L.K. Doraiswamy	Member	Sub-group on R&D in Petrochemicals appointed by the Planning Commission
	Member	Steering Committee on Fuels from Biomass-DST
	Member	Hindustan Lever Research Foundation, Bombay (Industrial Chemicals Panel)
	Member	ISI-Chemical Division Council
	Member	R&D Advisory Committee-Fertilizer Assocation of India
	Member	Award Committee - K.G. Naik Gold Medal, M.S. University of Baroda
	Member	International Reviewer, Panel of Applied Mechanics Reviews (S.E. Res. Inst., Texas, USA)
	Member	National Organizing Committee (INSA) of the 7th International Fermentation Symposium (1984)
	Member	Editorial Advisory Board of Advances in Transport Phenomena (Wiley Group)
	Member	CSIR-Chemical Engineering Research Committee

6. Dr. L.K. Doraiswamy (Contd.)	Member	DST-Science Engineering Research Council
	Member	Sub-group on Conversion and Utilisation of Biomass-DST Chairman Sub-group of Steering Committee on Fuels from Biomass-DST
	Member	R&D Group Hindustan Antibiotics Ltd,Pimpri, Pune
	Member	CSIR Polytechnology Transfer Centre (Bombay) - Advisory Council
	Member	Technical Advisory Committee for Chemical Industry - Kerala State Industrial Development Corpn. Ltd.
	Member	Development Council for Inorganic Chemical Industries, Ministry of Industry, Govt. of India
	Member	Scientific Advisory Board - Nimbkar Agriculture Research Insitutue, Phaltan
	Member	Scientific Advisory Committee, Dept. of Petroleum, Ministry of Petroleum, Chemicals and Fertilizers, Govt. of India.
	Part-time Director	Indian Petrochemicals Corpn. Ltd., Vadodara
	Part-time Director	Hindustan Organic Chemicals Ltd, Rasayani
	Chairman	CSIR Advisory Committee on Engineering (JRF/SRF)
	Chairman	Technical Manpower Committee, Govt. of Maharshtra
	Member	Council of Indian National Science Academy, New Delhi (1983-85)
	Member	Governing Council and Academic Council, IAT, Pune
	Member	ICMA Awards Selection Committee (1983)
	Member	University of Poona Senate
	Member	A Committee on new technology and innovation set up by the Association of Indian Engineering Industry
	Member	Academic Committees of National Defence Academy, Pune and Army Cadet College, Dehra Dun
	Chairman	CSIR Review Committee to review the functioning of Field/Regional Centres of National Laboratories/Institutes and Polytechnology Transfer Centres, etc.
	Member	CSIR Standing Committee for Emeritus Scientists

6. Dr. L.K. Doraiswamy (Contd.)	Member	Development of Western Ghat Committee
	Chairman	Programme Advisory Committee for Chemical Engineering Sciences Programme (constituted by the DST for 3 years from 16-8-1984)
	Chairman	Coordination Council, Chemical Sciences Group (1.10.84 to 30.9.86)
	Member	Governing Body and the Society of CSIR (1.10.84 to 30.9.86)
	Chairman	Committee appointed by the DGSIR for working out a training programme in the use and applications of computers
	Member	Working Group for DST for preparing the 7th Five Year Plan (1985-90)
	Member	Expert Group for preparing a perspective plan for the optimum utilisation of molasses and for evolving a national policy for the complimentary produced from petroleum feed-stocks (Ministry of Chemicals & Fertilizers)
	Member	Editorial Board of the Journal of Scientific and Industrial Research from (Jan 86 to Dec 88)
	Member	Governing Council of the Deccan Sugar Institute, Pune
	Member	Scientific Advisory Committee for the Petroleum, Ministry of Energy
7. Dr. S. Gundiah	Member	Governing Council of Indian Rubber Manufacturers' Research Assocation, Bombay
8. Dr. T.N. Guru Row	Member	Advisory Committee, National Information Centre for Crystallography (NICRYS)
9. Dr. S.H. Iqbal	Member	Advisory Committee for CSIR exhibitions to advise on the exhibition policy and organisation of exhibition in India and abroad
10. Dr. S.S. Katti	Member	Executive Committee of the Indian Society for Surface Science and Technology, Jadavpur University, Calcutta
11. Dr. B.D. Kulkarni	Member	Research Advisory Committee of the IPCL R&D programme
12. Dr. A.F. Mascarenhas	Member	Research Advisory Committee of ICAR on Biotechnology
	Member	Research Advisory Committee of Poona University on Biotechnology
	Member	Indo-US Panel on Biomass
	Secretary	Plant Tissue Culture Assocation of India

13. Dr. R.A. Mashelkar	Editor (India)	Chemical Engineering Communications, Gordon Breach (USA)
	Editor (India)	Rheological Acta, Dr. Dietrich Steinkopff Verlag (Germany)
	Editor (India)	J. Non-Newtonian Fluid Mechanics, Elsevier (Holland)
	Editor	Advances in Transport Processes, Wiley Eastern/Wiley Halsted
	Member	Editorial Board, Indian Journal of Technology
	Member	Publications Committee, Indian Chemical Engineer
	Member	Editorial Advisory Board, Polymer Materials, Oxford and IBH Publishing Company
	Member	Reviewer's Board, Applied Mechanics Review, USA
	Member	Abstractors' Board, Rheology Abstracts, British Society of Rheology, UK
	Member	Chemical Engineering and Material Science Research Committee of CSIR
	Member	Industrial Chemistry and Chemical Technology Research Committee of CSIR
	Member	Project Advisory Committee on Resins and Composites, Department of Science and Technology (1983-84)
	Secretary	International Chemical Reaction Engineering Conference (1983-84)
	Member	Board of Studies in Chemical Eningeering and Technology, Banaras HIndu University (1983)
	Member	Board of Studies in Polymer Science, University of Madras (1983)
	Member	Selection Committee for Dunlop Award given on a national basis (1983)
	Member	Evaluation Committee, Maharshtra Gas Cracker Complex and Salimpur Complex, Ministry of Petroleum (1982-85)
	Chairman	Committee to evaluate CIPET (Madras) as a post-graduate education centre (1983)
	Member	Expert Committee to evaluate SASMIRA'S fibre pilot plant, Ministry of Industry (1983)

13. Dr. R.A. Mashelkar (Contd.)	Member	National Co-ordination for Polymer Science and Engineering R&D plan for the seventh five year plan of CSIR (1984)
	Member	Research Advisory Committee, IPCL (Baroda), (1984)
	Member	Research Consultative Committee, HAL, Pune (1984)
	President	Society for Polymer Science in India (1984-85)
	Member	The Council of Indian National Science Academy for three years term starting from 1986
	Member	Sectional Committee to elect the Fellows of the Indian Academy of Sciences from Engineering Sciences discipline for three years from 1986
	Member	Committee to select the Shanti Swarup Bhatnagar prizes in Engineering Sciences for the year 1984
	Member	Working Group to examine the involvement of inspecting agencies under explosives act/rules, Ministry of Industry (1986)
	Member	Committee to examine modern polycondensation processes/technologies, Ministry of Industry (1986)
	Member	Committee to monitor and implement the project on performance optimisation at IPCL Petrochemical Complex, UNDP project of Govt. of India.
	Member	Interministerial Group for Control of hazards in chemicals, fertilizers and pharmaceuticals (Nominee of Secretary, Dept. of Scientific and Industrial Research)
14. Dr. R.B. Mitra	Member	Development Council for Organic Chemicals consituted by the Ministry of Petroleum and Chemicals, New Delhi
	Member	Central Insecticides Board, Faridabad
	Member	Research Advisory Council, RRL, Jorhat
15. Dr. V.M. Nadkarni	Member	Polymer Technology Selection Team for Maharshtra Gas Cracker Compex, Oil Industry Development Board, Ministry of Petroleum
	Member	ISI Committee on (i) Plastic Pipes Sub-Committee and (ii) Chemical Engineering Selection Committee
	Member	Metallurgical and Chemical Engineering Research Sub-Committee, Central Board of Railway Research, Ministry of Railways
	Advisor	Technical Advisor to projects on High performance fibres and resins for composites, Department of Science and Technology, Govt. of India

15. Dr. V.M. Nadkarni (Contd.)	Member	Executive Committee, National Chemical Laboratory
	Member	Project Coordination Committee, Technology Park, Pune University
	Member	Committee for Technology for Modernization of Railways, Ministry of Railways
	Member	DGTD Committee for evaluation of PET X-ray film technology
	Member	DSIR Evaluation committee for technology status report on DMT/PSE
16. Dr. U.R. Nayak	Member	Sub-Committee of the Development Committee for Oleoresins, Gums and Essential Oils
	Member	Sub-Committee on Synthetic Perfumery Materials - PCDC
17. Dr. P.K. Ranjekar	Member	Executive Committee of Society of Biological Chemists of India
	Member	Executive Committee of Indian Society of Cell Biology
18. Dr. V.J. Rao	Member	National Advisory Committee of the International Conference on the physics and technology of compensated semi-conductor held at IIT, Madras
19. Dr. P. Ratnasamy	Member	Editorial Board of the Fuel Science and Technology (Journal brought out by CFRI, Dhanbad)
20. Dr. T. Ravindranathan	Member	Expert Group on Drugs for Safety in Chemical & Petrochemical Industries
	Member	Safety Survey Committee Expert Group II Private Sector-Chemical Unit Formed by Ministry of Industry, Govt. of India 1986
21. Dr. S.C. Sethi	Member	Natural and Synthetic Perfumery Materials Sectional Committee, PCDC 18, ISI, New Delhi
22. Dr. M.S. Setty	Member	Screen Printing Association of India, Bombay
	Member	Executive Committee on International Society for Hybrid Microelectronics Grade of Institute of Engineers India, Calcutta
23. Dr. A.P.B. Sinha	Member	Materials Research Committee, Dept. of Atomic Energy
24. Dr. R.N. Sharma	Member	Board of Research Studies in Zoology, Shivaji Univ., Kolhapur
	Member	Ph.D. Admission Committee in the Faculty of Science, Univ. of Poona

25. Dr. M.C. Srinivasan	Nominated Member	World Federation Culture Collections Specialist Committee on Endangered culture collections	
26. Dr. R. Tewari	Member	Regional Computer Centre Users Committee, (NCL nominee)	

8.6 Post-graduate degrees received by NCL staff members and research fellows/guest workers

Sl. No.	Name	Degree	University	Subject of thesis	Guide
1	2	3	4	5	6
1.	Miss G.S. Annapurna	Ph. D.	Poona	Synthesis of some biologically active compounds	Dr. A.V. Rama Rao
2.	Mr. P.P. Bakare	Ph. D.	Poona	Structural, electronic and magnetic studies on metalic oxides and ferrites	Dr.S.K. Date
3.	Mr. I. Balakrishnan	Ph. D.	Poona	Catalytic reactions over ZSM-5 type zeolites	Dr.(Miss) S.B.Kulkarni
4.	Mr. S. S. Bhosale	Ph. D.	Poona	Synthetic studies in biologically active organic compounds	Dr. G.H. Kulkarni
5.	Mrs. Sujata Biswas	M.Sc.	Poona	Studies in chromatographic separations	Dr. N.R. Ayyangar
6.	Mr. H.B. Borate	Ph. D.	Poona	Studies directed towards the synthesis of anthracyclines	Dr. A.V. Rama Rao
7.	Mr. S.P. Chavan	Ph. D.	Poona	Synthesis of some biologically active compounds	Dr. A.V. Rama Rao
8.	Mr. S.K. Chaudhari	M.Sc.	Salford (UK)	Performance studies on an absorption heat pump	*Prof. F.A. Holland
9.	Mr. A.C. Choube	Ph. D.	Poona	Reactions involving silicon halides	Dr. A.P.B. Shinha
10.	Mr. A.R. Choudhari	Ph. D.	Bombay	Analysis of alkylation reactions	Dr. N.R. Ayyangar
11.	Mr. V.D. Deuskar	Ph. D.	Poona	Studies on rheological properties of polymers	Dr. P. Roy Chowdhury
12.	Miss Kamini Garyali	Ph. D.	Poona	Synthesis of some biologically active compounds	Dr. A.V. Rama Rao
13.	Mr. N.M. Goudgon	Ph. D.	Poona	Studies in phytochemistry	Dr. U.R. Nayak
14.	Mr. Ishwar Chandra	M.Sc.	Salford (UK)	Experimental studies on heat pump assisted distillation	*Prof. F.A. Holland

15. Mr. G.S. Jadhav	Ph. D.	Shivaji	Studies in synthesis of new chromophoric and biologically active compounds	Dr. G.T. Panse
16. Mr. P.L. Joshi	Ph. D.	Poona	Synthesis of quinones, polycyclic compounds and some transformations of carbohydrates	Dr.A.S. Rao
17. Mrs. M. Kamalam	M.Sc.	Poona	Synthesis of some biologically active compounds	Dr. A.V. Rama Rao
18. Miss R.S. Khisti	Ph. D.	Shivaji	Renewable resource materials for polymer applications	Dr. N.D. Ghatge
19. Mr. A.N. Kotasthane	Ph. D.	Poona	Synthesis and characterisation of ZSM type pentasil zeolites	Dr. (Miss) S.B. Kulkarni
20. Mrs. A.D. Kulkarni	Ph. D.	Poona	Synthesis of analogues and anthracyclines	Dr. A.V. Rama Rao
21. Mr. S.Y. Kulkarni	Ph. D.	Poona	Analytical methods in organic chemistry	Dr. V.S. Pansare
22. Mr. Joseph Kuruvilla	Ph. D.	Poona	Synthetic studies in the chemistry of carbonyl complexes of Ruthenium, Rhodium and Iridium	Dr. C. Gopinathan
23. Mr. B.G. Mahamulkar	Ph. D.	Poona	Transformation of (+) −3− carene synthesis of pyrethroids	Dr. R.B. Mitra
24. Mr. R.B. Malvankar	Ph. D.	Poona	Studies in analytical methods in organic chemistry	Dr. V.S. Pansare
25. Mr. R.H. Naik	Ph. D.	Poona	Synthetic studies in terpenes	Dr. G.H. Kulkarni
26. Mr. S.R. Otiv	Ph. D.	Bombay	Studies in synthetic dyes : New chromophoric systems	Dr. N.R. Ayyangar
27. Mr. D.V. Paranjape	M.Sc.	Salford (UK)	A performance study of aqueous salt system in absorption heat pump	*Pro. F.A. Holland
28. Mr. V.J. Patil	Ph. D.	Poona	Synthesis of some biologically active compounds from carbohydrates	Dr. A.V. Rama Rao
29. Mr. R.M. Patil	Ph. D.	Poona	Studies on cellulases	* Dr. J.C. Sadana
30. Mr. A.S. Phadke	Ph. D.	Poona	Synthesis of biologically active compounds	Dr. S.N. Kulkarni
31. Mr. S.S. Ramdasi	Ph. D.	Poona	Analytical studies of oxidants for catalytic oxidation of organic comounds	Dr. V.S. Pansare
32. Mr. R.S. Randad	Ph. D.	Poona	Synthetic transformations leading to biologically active compounds	Dr. G.H. Kulkarni

33.	Mr. S. Pulla Reddy	Ph. D.	Poona	Synthesis of some biologically active compounds from natural products	Dr. A.V. Rama Rao
34.	Mr. P.S. Reddy	Ph. D.	Poona	Synthesis of some biologically active compounds	Dr. A.V. Rama Rao
35.	Mr. N. Satyanarayana	Ph. D.	Poona	Studies in sesquiterpens: New aspects of longifolene	Dr. U.R. Nayak
36.	Mr. K. Sivadasan	Ph. D.	Poona	Expansion coefficients in polyelectrolytes : An investigation of polymeth-acrylic acid solutions by light scattering and viscosity	Dr. S. Gundiah
37.	Mr. D.G. Talekar	Ph. D.	Poona	Applications of lead tetracetate in synthesis of organic chemistry and studies on transformation of carbohydrates and their analogues	Dr. A.S. Rao
38.	Mrs. G.A. Thite	M.Sc.	Poona	Absorption of reaction species	Dr. V.R. Choudhary
39.	Mr. M.B. Unde	M.S.c	Salford (U.K)	Heat pump assisted distillation	*Prof. F.A. Holland
40.	Mr. M. Udaykumar	Ph. D.	Poona	Photochemical transformations of some organic molecules	Dr. H.R. Sonawane
41.	Mr. H.K. Venkataramiah	Ph. D.	Bombay	Studies in synthetic dyes	Dr. N.R. Ayyangar
42.	Mr. V. Vidyasagar	Ph. D.	Poona	Synthesis of some biologically active compounds	Dr. N.R. Ayyangar

* Guide not from NCL/Emeritus Scientists

8.7. NCL scientists recognised by different universities as research guides

1.	Dr. Ayyangar, N.R.	Bombay, Poona
2.	Dr. Barnabas John	Poona
3.	Dr. Brahme, P.H.	Poona
4.	Dr. Chaudhari, R.V.	Poona, Shivaji
5.	Dr. Chaudhary, V.R.	Poona, Shivaji
6.	Dr. Date, S.K.	Poona
7.	Dr. Deshpande, M.V.	Poona
8.	Dr. Deshpande, V.H.	Poona
9.	Dr. Deshpande, V.V.	Poona

10.	Dr. Doraiswamy, L.K.	Banaras, Bombay, Calcutta, Jadhavpur, Nagpur, Poona, Salford (UK)
11.	Dr. Gokarn, A.N.	Poona
12.	Dr. Gopinathan, C	Marathwada, Poona
13.	Dr. Gundiah, S.	Karnataka, Poona
14.	Dr. Harish Narain	Shivaji
15.	Dr. Jose, C.I.	Poona
16.	Dr. Katti, S.S.	Bombay, Poona
17.	Dr. Krishnamurthy, K.V.	Poona, Shri Venkateshwara
18.	Dr. Kulkarni, B.D.	Poona
19.	Dr. Kulkarni, G.H.	Nagpur, Poona
20.	Dr. Kulkarni, M.G.	Poona
21.	Dr. Kulkarni, S.N.	Bombay, Karnataka, Poona, Shivaji
22.	Dr. Lachke, A.H.	Poona
23.	Dr. Mahajan,S.S.	Poona
24.	Dr. Mascarenhas, A.F.	Poona
25.	Dr. Mashelkar, R.A.	Banaras, Bombay, Nagpur, Poona, Salford (UK)
26.	Dr. Mitra, R.B.	Bombay, Poona
27.	Dr. Nadkarni, V.M.	Poona, IIT, Delhi
28.	Dr. Nagasampagi, B.A.	Poona
29.	Dr. Nayak, U.R.	Poona, Shivaji
30.	Dr. Pansare, V.S.	Poona
31.	Dr. Panse, G.T.	Poona, Shivaji
32.	Dr. Pant, L.M.	Poona
33.	Dr. (Mrs.) Patwardhan, S.A.	Poona
34.	Dr. Patwardhan, V.S.	Poona, Shivaji
35.	*Dr. Rama Rao, A.V.	Bombay, Kakatia, Poona, Shivaji, Venkateshwara
36.	Dr. Ranjekar, P.K.	Poona, Shivaji

37.	Dr. (Mrs.) Rao Mala	Poona
38.	Dr. Rao, A.S.	Bombay, Shivaji, Poona
39.	Dr. Rao, V.J.	Poona
40.	Dr. Ravindranathan, T.	Bombay, Marathwada , Shivaji, Poona
41.	Dr. Roy Choudhury, P.	Marathwada, Poona, Shivaji
42.	*Dr. Sadana, J.C.	Aligarh, Poona
43.	Dr. Sethi, S.C.	Poona
44.	Dr. Sharma, R.N.	Poona, Shivaji
45.	Dr. Shankar, V.	Poona
46.	Dr. Sinha, A.P.B.	Banaras, Bombay, Poona, Shivaji
47.	Dr. (Mrs.) Siva Raman, H.	Poona
48.	*Dr. Siva Raman, C.	Poona
49.	Dr. Sonawane, H.R.	Marathwada, Poona
50.	Dr. Srinivasan, M.C.	Poona, Shivaji
51.	Dr. Tewari, R.	Poona
52.	Dr. Umapathy, P.	Poona
53.	Dr. Varma, A.J.	Poona
54.	Dr. Vartak, H.G.	Poona, Shivaji
55.	Dr. Vernekar, S.P.	Poona, Shivaji

* Not in NCL/Emeritus Scientists

9. PAPERS PRESENTED AT SYMPOSIA, SEMINARS, ETC.

1. Choudhary, V.R. and Nayak, V.S.,
   Titration of active acid sites on H-ZSM-5 by selective poisoning with pyridine,
   International symposium on zeolite catalysis, Siofok (Hungeri), May, 1985.
2. Krishnamurthy, K.V.,
   Protoplast technology, for genetic engineering,
   NBTB training course on plant molecular biology NCL, Pune, May 1985.
3. Mascarenhas, A.F.,
   Plant tissue culture : Some applications
   NBTB training course on plant molecular biology, NCL, Pune, June, 1985.
4. Patwardhan, S.A., Phadnis, A.P., Gund P. and Sharma, R.N.,
   Geranyl based diethers as Juvenile Hormone Mimics,
   National seminar on behavioural, physiological approach in the management of crop. pests, Tamilnadu Agri. University, Combatore, June, 1985.
5. Nanda, B., Butalia, M.S., Patwardhan, S.A. and Gupta, A.S.,
   Role of pheromones in integrated pest management,
   National seminar on behavioural physiological approach in the management of crop. pests, Tamilnadu Agri. University, Coimbatore, June, 1985.
6. Sharma, R.N.,
   A critical analysis of the scope of plant products in plant protection now, in future,
   National seminar on behavioural and physiological approaches in the management of crop pests, Tamilnadu Agri. University, Coimbatore, June, 1985.
7. Rawal, S.K.,
   Synthesis and transport of proteins into chloroplast small subunits of ribulose biphosphate carboxylase - A case study,
   NBTB training course on plant molecular Biology, NCL, Pune, July, 1985.
8. Shukla, P.G., Amarnath, N., Jaffe H., Hayers, D.K., Luthra, R.P. and Chaney N.A.,
   Controlled release microcapsules of insect steroids harmone analogues,
   12th International symposium on controlled release of bioactive materials, Geneva, July, 1985.
9. Mascarenhas, A.F.,
   Plant tissue culture - A prospective consumer oriented technology,
   International workshop on molecular biosciences and biotechnology, SPIC, Madras, August, 1985.
10. Lachke, A.H., Rajan, J.V. Srinivasan, M.C. and Tambe, S.A.,
    Cellulose and hemicellulose bioconversions to fuels and feedstocks ,
    Information need for technology development, National seminar on bio-energy information sources, New Delhi, August, 1985.
11. Kulkarni, P.S., Mirajkar, S.P., Bambal, R.B. and Ayyangar, N.R.,
    Comparison between mass spectral, thermal and photochemical reactions of substituted 1-H-azepines,
    Third national symposium on mass spectrometry, RRL., Hyderabad, September, 1985.
12. Rajan, J.V. and Ayyangar, N.R.,
    Sugarcane extractives,
    35th Annual convention of the Deccan Sugar Technologists Association, Pune, September, 1985.
13. Mascarenhas, A.F.,
    Plant tissue culture : A rapidly growing technology,
    Workshop on technology park at University of Poona, Pune, October, 1985.
14. Deshpande, C.E., Sinha, A.P.B., Kulkarni, S. and Date, S.k.,
    X-ray photoelectron spectroscopic studies on oxides of manganese and manganites : An overview,
    National seminar on X-ray spectroscopy, Nagpur, October, 1985.
15. Rajan, J.V. and Ravindranathan, T.,
    Public sector and national drug policy - A decade after Hathi Committee,
    Kerala Sastra Sahitya Parishad, November, 1985.
16. Tewari, R.,
    Conformational implications of base hypermodifications in the anticodon loops of tRNA,
    5th Annual general body meeting of the society of biological chemists, Pantnagar, November, 1985.
17. Badam, L., Kulkarni, M.M., Nagasampagi, B.A. and Wagh, U.V.,
    Effect of some plant extracts on *Plasmodium falciparum* in vitro : Part I,
    VI National cong. of parasites, November, 1985.

18. Tewari, R.,
Quantum chemical studies on hypermodified nucleic acid bases : Conformation of N_6 (2-isopentenyl) adenine,
National conference on spectroscopy and theoretical chemistry, Calcutta, December, 1985.

19. Deshmukh, K.K., Waghmare, K.J. and Sivasankar, S.,
Acidic and catalytic properties of some oxides and mixed oxides,
Workshop on catalysis and catalysts in chemical industries, Bhubaneshwar, December, 1985.

20. Padalkar, S.R., Kantak, U.N. and Sivasanker, S.,
Studies on the catalytic properties of Pt and Pt-Re reforming catalysts,
Workshop on catalysis and catalysts in chemical industries, Bhubaneshwar, December, 1985.

21. Sethi, S.C., Adyanthaya, S.D., Deshpande, S.D., Kelkar, R.G., Natarajan, N. and Katti, S.S.,
Sucrose esters versus sodium dodecylbenzene-sulfonate - A comparative study of surfactant properties,
National symposium on surfactants, emulsions and biocolloids, Indian Institute of Technology, New Delhi, December, 1985.

22. Panse, M.D.,
Use of literature by the NCL scientists : A citation analysis,
15th IASLIC conference, Bangalore, December, 1985.

23. Nadkarni, V.M.,
Polymer Industry in India : Present status and future potentials,
Seminar on business opportunities in plastics processing industry, MITCON, Pune, December, 1985.

24. Sharma, R.N., Tungikar, V.B. and Joseph, M.,
Towards new approaches for cleaner, safer and scientific pest management,
National symposium on industrial pollution and pesticides in the context of Bhopal tragedy. University of Gorakhpur, December, 1985.

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Safer, easier and cheaper pest management systems: A novel approach,
National conference on key pests of agricultural crops, CSA University of Agri. and Technology, Kanpur, December, 1985.

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Novel methods to solve difficult structure using MULTAN package,
XVII National seminar on crystallography, University of Madras and I.I.T., Madras, December, 1985.

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Conformational features in differently substituted longifolenes II : Structure of two pseudoisomorphic modifications,
XVII National seminar on crystallography, University of Madras, and I.I.T., Madras, December, 1985.

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Substituted quinolines as chemotherapeutic agents : Structure of two derivatives,
XVII National seminar on crystallography, University of Madras, and I.I.T. Madras, December, 1985.

29. Vedavati G. Puranik, Tavale, S.S. and Guru Row T.N.,
A structure with a locked in C-H... O interaction : l-formyl-8-methoxy-3-methyl-5, 6-dihydrobenz (f) isoquinolin-(3H)-2-one,
XVII National seminar on crystallography, University of Madras and I.I.T., Madras, December, 1985.

30. Bendale, R.D., Gadre, S.R. and Guru Row T.N.,
Molecular deformation densities : A new approach to study intermolecular interactions, xvii National seminar on crystallography, University of Madras and I.I.T., Madras, December, 1985.

31. Krishna, S., Vasantha Pattabhi and Guru Row T.N.,
Crystal structure of nicotinylglycine,
xvii National seminar on crystallography, University of Madras, and I.I.T., Madras, December, 1985.

32. Ogle, S.B., Phase, D.M., Patil, P.P., Ghaisas, S.V., Kanetkar, S.M., Bhide V.G. and Date S.K.,
Ion beam mixing at Fe : Al_2O_3 interface : A conversion electron mossbauer spectroscopic study,
International conference on applic mossbauer effect, Belgium, 1985.

33. Shrotri, J.J. Deshpande, C.E., Date, S.K. and Ogle, S.B.,
Chemical passivation of unstable FeO - A mossbauer study,
International conference on applic mossbauer effect, Belgium, 1985.

34. Deshpande, C.E., Date, S.K. and Hauser, J.J.,
Spin- glase behaviour in stabilized MnO,
DAE symposium on solid state physics, Nagpur, December, 1985.

35. Mascarenhas, A.F.,
Application of plant tissue culture : Possibilities, advantages and limitations,
College of Agri. Banking, Pune, January, 1986.

36. Nadgauda, R.S.,
Plant tissue culture : Cardamom day,
RRL, Trivandrum, January, 1986.

37. Kotasthane, A.N., Hegde, S.G. and Rao, B.S.,
Synthesis and physico-chemical properties of some ZSM zeolites,
3rd National workshop on catalysis and catalysts in chemical industries,
RRL, Bhubaneshwar, February, 1986.

38. Chandwadkar, A.J. and Shiralkar, V.P.,
Influence of mixed cation species on sorption properties of ZSM-5 type zeolites,
3rd National workshop on catalysis and catalysts in chemical industries, RRL, Bhubaneshwar, February, 1986.

39. Deshpande, S.G. and Sharma, R.N.,
Insect antifeedant action of some forest seed oils,
National symposium on insect physiology, ecology and behaviour, Trivandrum, February, 1986.

40. Nadkarni, V.M. and Jog, J.P.,
Interrelationship between the crystallization behaviour, injection moulding conditions and morphology of PET/PMMA alloys,
International Symposium on Polyblends, Montreal, Canada, February, 1986.

10 PATEN

arni (Miss.), S.B., Shiralkar, V.P., avar, K.H.

Indian patents

1. 148132
A process
naphthoquin
polyester fibr
Ayyangar, N.R
K.B.

2. 149249
An improved a
determination of
or sulphur in orga
d coal, steel
and like materials.
Malvankar, R.B., Ramdasi, S.S. and Pansare, V.S.

3. 150391
Synthesis of a new isecticide belonging to the synthetic pyrethroids group.
Mitra, R.B., Kulkarni, G.H., Gore, K.G., Muljiani (Miss), Z., Khanna, P.N., Joshi, G.D., Khanra, A.S., Choudhari, P.N. and Bhawal, B.M.

4. 151660
A novel process for recovery of D (+) camphorsulphonic acid during the resolution of DL phenylglycine.
Mitra, R.B., Joshi, B.N., Hinge, V.K. and Natekar (Miss), M.V.

5. 152306
Process for the preparation of 3-phenoxybenzyl IR-cis-2, 2-dimethyl-3 (2-cyanoprop-l-enyl) cyclopropane carboxylate.
Mitra, R.B., Kulkarni, G.H., Mulijiani (Miss), Z. and Khanna, P.N.

6. 153336
A new process for the preparation of IR-cis-2, 2-dimethyl (2-oxopropyl) cyclopropane carboxylic acid, an important intermediate in the synthesis of insecticides of the synthetic pyrethroids group by oxidation of 3, 6, 6-trimethyl 4-formyl (3, 1, 0)-bicyclo-hex-3-ene using suitable oxidising agents.
Mitra, R.B., Kulkarni, G.H., Gore, K.G., Muljiani (Miss), Z., Khanna, P.N., Joshi, G.D. and Bhawal, B.M.

7. 153415 (869/DEL/79)
A process for the isolation of a fraction from neem extract enriched with active principle exhibiting oviposition deterrent and anti-feedant activity against potato tuber moth.
Nagasampagi, B.A., Sharma, R.N., Kulkarni (Miss), M.M., Bhosale, A.S. and Tungikar, V.B.

8. 153460 (798/DEL/79)
Process for the preparation of ∝ -cyano-3--phenoxy-benzyl l-R-cis-2, 2-dimethyl-3-(2-chloro-prop-l-enyl) cyclopropane carboxylate, a new insecticide belonging to the synthetic pyrethroids group.
Mitra, R.B., Kulkarni, G.H., Gore, K.G., Muljiani (Miss), Z., Khanna, P.N., Joshi, G.D. and Bhawal, B.M.

9. 153587 (942/DEL/79)
Process for the preparation of a novel controlled release mosquito larvicide.
Das, K.G., Mirajkar, S.P. and Tungikar, V.B.

10. 153634 (91/DEL/80)
An improved chemical process for the manufacture of high alpha cellulose pulp from naturally occurring cellulosic materials.
Bendale, D.S., Mahajan, M.B. and Karnik, R.S.

11. 153878 (208/DEL/80)
A new process for the preparation of 2, 2-dimethyl-3- (2-oxopropyl) -cyclopropane acetic acid, an important intermediate in synthesis of chrysanthemic acid and synthetic pyrethroid insecticides.
Mitra, R.B., Hinge, V.K. and Khanra, A.S.

12. 154233 (950/DEL/79)
A process for the preparation of blue naphthostyril cationic dyes.
Ayyangar, N.R., Moghe, P.P. and Tilak, B.D.

13. 154331 (378/DEL/80)
A process for the selective isolation of vinblastine sulphate from the leaves of Vinca rosea (Catharanthus roseus G.Don.)
Rama Rao, A.V., Venkatswamy, G., Sathaye, K.M. and Yadagiri, P.

14. 154394 (453/DEL/80)
A new process for the preparation of IR-cis-2, 2-dimethyl-3-(2-oxopropyl) cyclopropane carboxylic acid, an important intermediate for the synthesis of pyrethroid insecticides.
Mitra, R.B., Joshi, G.D. and Khanra, A.S.

15. 154396 (512/DEL/80)
A new route for the preparation of IR, cis-2-2-dimethyl-3- (2-oxopropyl) cyclopropane-carboxylic acid, an important intermediate for the synthesis of pyrethroid insecticides.
Mitra, R.B. and Khanra, A.S.

16. 154460 (318/DEL/78)
A process for the preparation of new yellow to violet azo-N-substituted homophthalimide disperse dyes for synthetic fibres.
Ayyangar, N.R., Rao, U.S. and Tilak, B.D.

17. 154665 (425/DEL/80)
An improved method for the preparation of IR-cis-2, 2-dimethyl-3--(2-hydroxy-2-carboxypropyl) cyclopropane carboxylic acid from car-4-ene-3-ol.
Mitra, R.B., Kulkarni, G.H., Muljiani (Miss), Z., Naik, V.G. and Deshmukh, A.R.A.S.

18. 154666 (426/DEL/80)
A method for the preparation of Y-lactone of IR-cis-2, 2-dimethyl-3-hydroxymethyl cyclopropane carboxylic acid from methyl IR-cis-2, 2-dimethyl-1-3 (2-oxopropyl) cyclopropane carboxylate.
Mitra, R.B., Kulkarni, G.H., Khanna, P.N. and Joshi, G.D.

19. 154667 (444/DEL/80)
A process for the manufacture of sodium hydrosulphate via ferrous hydrosulphite.
Gopinathan, C., Gopinathan (Mrs.), S., Unni, I.R., Awasarkar, P.A., Pandit, S.K. Pardhy (Mrs.), S.A., Chatterjee, A.K. and Sonsale, A.Y.

20. 154669 (581/DEL/80)
Catalyst and process for the conversion of alcohol to hydrocarbons.
Kulkarni (Miss), S.B., Ratnasamy, P., Balkrishnan, I., Rao, B.S., Chandwadkar (Mrs.), A.J. and Kotasthane, A.N.

21. 154702 (900/DEL/80)
Improved process for the conversion of toluene to xylenes.
Kulkarni (Miss), S.B., Ratnasamy, P., Kotasthane, A.N., Chandwadkar (Mrs.) A.J., Babu, G.P. and Chandavar, K.H.

Indian patent applications accepted

1. 155205 (843/DEL/80)
A process for the preparation of catalyst.
Kulkarni (Miss), S.B., Ratnasamy, P., Kotasthane, A.N., Chandwadkar (Mrs.), A.J., Babu, G.P. and Chandavar, K.H.

2. 155892 (290/DEL/81)
Process for the catalytic conversion of alkylaromatic hydrocarbons into paraxylenes.
Ratnasamy, P., Kulkarni (Miss), S.B., Rao, B.S., Kotasthane, A.N., Chandwadkar (Mrs.), A.J., Kulkarni, S.J. and Hegde, S.G.

3. 155893 (291/DEL/81)
Process for the preparation of a catalytic composite material.
Kulkarni (Miss), S.B., Ratnasamy, P., Shiralkar, V.P., Balkarishnan, I. and Kavedia, C.V.

4. 157061 (630/DEL/81)
Improved process for the disproportionation of toluene to benzene and xylene.
Ratnasamy, P., Kulkarni (Miss), S.B., Babu, G.P., Chadavar, K.H., Balakrishnan, I., and Shiralkar, V.P.

Indian patents applications filed

1. 702/DEL/79
A process for the reactive dyeing of cellulosic fibres by the application of 6-cyano-7-methyloxaz-olo (3, 2-a) pyrid-5 (4H) - one followed by treatment with diazonium salts.
Ayyangar, N.R., Rao, U.S. and Tilak, B.D.

2. 703/DEL/79
A process for the preparation of new yellow to blue azopyride-2-one pendant cationic dyes for acrylic fibres.
Ayyangar, N.R., Rao, U.S. and Tilak, B.D.

3. 922/DEL/79
A process for the preparation of new yellow to violet azo disperse dyes derived from morpholinonaphthalenes for application to synthetic fibres.
Ayyangar, N.R., Moghe, P.P. and Tilak, B.D.

4. 949/DEL/79
A process for the preparation of new blue azo disperse dyes from 3-chloro 1,2,3,4-tetrahydro-7, 8-benzoquinoline and the isomeric 2-(chloromethyl)-benz-(g)-indoline for the application of synthetic fibres.
Ayyangar, N.R., Moghe, P.P. and Tilak, B.D.

5. 599/DEL/80
A process for the preparation of new yellow naphtho-quinoquinezolinedione disperse dyes for polyester fibres.
Ayyangar, N.R., Deshpande, R.J. and Wagle, D.R.

6. 669/DEL/80
Catalyst and process for the selective conversion of ethylene into aromatic hydrocarbons containing 6 to 8 carbon atoms.
Ratnasamy, P., Kulkarni (Miss), S.B., Balakrishnan, I., Rao, B.S. and Shiralkar, V.P.

7. 732/DEL/80
Catalyst and process for the alkylation of benzene to ethylbenzene.
Ratnasamy, P., Kulkarni (Miss.), S.B., Shiralkar, V.P., Babu, G.P. and Chandavar, K.H.

8. 702/DEL/81
A process for the preparation of improved cellulose acetate,
Ghatge, N.D., Sabne, M.B. and Gujar, K.B.

9. 703/DEL/81
Improved process for the preparation of ethyl-(carbethoxy) - β (substituted anilino) acrylates.
Ayyangar, N.R., Jinaraj, V.K., Lahoti, R.J. and Danial, T.

10. 707/DEL/81
An improved process for the preparation of aromatic hydrocarbons from ethyl alcohol in a single step conversion.
Kulkarni (Miss), S.B. Ratnasamy, P., Balakrishnan, I., Rao, B.S., Chandwadkar (Mrs.), A.J. and Kotasthane, A.N.

11. 804/DEL/81
Process for the synthesis of new 3, 6-diary 1-3-4 dihydro 1, 3, 2-oxazaphosphorin-2-oxides.
Tilak, B.D., Gogte, V.N. and Modak, A.S.

12. 44/DEL/82
An improved process for the catalytic alkylation of benzene to ethylbenzene.
Ratnasamy, P., Kulkarni (Miss.), S.B., Shiralkar, V.P., Babu, G.P. and Chandavar, K.H.

13. 78/DEL/82
An improved process for the preparation of substituted aromatic diamines.
Ghatge, N.D. and Maldar, N.N.

14. 96/DEL/82
A novel device for solar thermal conversion in which fluid is used as an absorbing medium.
Sathaye, S.D., Potadar, H.S. Soni, H.S. and Sinha, A.P.B.

15. 476/DEL/82
An improved process for the preparation of N-alkyldiiso-propanolamine.
Nerlekar, P.G. and Moghe, P.P.

16. 478/DEL/82
A process for the preparation of stable manganous oxide (MnO).
Murthy, M.N.S., Deshpande, C.E., Bakare, P.P. and Shrotri (Mrs.) J.J.

17. 670/DEL/82
An improved process for the preparation of thermoplastic polyurethane polymers.
Ghatge, N.D. and Jadhav, J.Y.

18. 57/DEL/83
Process for the preparation of open pore polymer gel beads with desired entrapped whole cells for use in fermentation reactions.
Siva Raman (Mrs.) H., Rao, B.S., Shankar, V., Pundle, A.V. and Siva Raman C.

19. 58/DEL/83
A catalytic process for the conversion of methanol to olefins.
Kulkarni (Miss.), S.B., Ratnasamy, P., Balakrishnan, I., Rao, B.S., Shiralkar, V.P., Hedge, S.G. and Kotasthane, A.N.

20. 115/DEL/83
A process for the preparation of composite catalyst material.
Kulkarni (Miss.), S.B., Ratnasamy, P., Balakrishnan, I., Shiralkar, V.P., Kotasthane, A.N., Rao, B.S. and Borade, R.B.

21. 275/DEL/83
Process for the preparation of crystalline catalyst composite material designated Encilite.
Ratnasamy, P., Borade, R.B. Kulkarni, (Miss.), S.B. and Hedge, S.G.

22. 296/DEL/83
A process for the preparation of homogeneous metal chiral ligands catalysts using natural alkaloids,
Gogte, V.N., Natu, A.A. and Ahuja (Miss.), R.R.

23. 370/DEL/83
Process for the catalytic conversion of methanol to hydrocarbons mainly olefins.
Ratnasamy, P., Kulkarni (Miss.), S.B., Balakrishnan, I., Rao, B.S., Shiralkar, V.P. Hedge, S.G. and Borade, R.B.

24. 437/DEL/83
A process for the conversion of alkanols to hydrocarbons.
Ratnasamy, P., Balakrishnan, I., and Rao, B.S.

25. 539/DEL/83
A novel process for the preparation of isocyanate terminated (Telechelic) diene prepolymers by free radical polymerization technique.
Ghatge, N.D., Vernekar, S.P. and Vadgaonkar, P.P.

26. 628/DEL/83
A process for the manufacture of benzene and xylenes admixtures from alkyl aromatic hydrocarbons.
Ratnasamy, P., Kulkarni, (Miss.), S.B., Meshram, N.R. and Hedge, S.G.

27. 585/DEL/83
An improved process for the preparation of 4-amino-3-nitrobenzophenone with or without alkyl substituents.
Ayyangar, N.R., Lahoti, R.J. and Thomas, D.

28. 115/DEL/84
A process for the preparation of 2, 2-dimethyl-3-(n-propyl) cyclopropane acetic acid by reaction of hydrazine hydrate with 2, 2-dimethyl-3-(2-oxopropyl) cyclopropane acetic acid.
Mitra, R.B., Joshi, B.N., Natekar (Miss.), M.V., Arabale, A.A. and Shinde, D.D.

29. 116/DEL/84
A process for the preparation of substituted alkyl, cyclohexyl, cyclohexylalkyl, aralkyl, aryloxyalkyl esters of 2, 2-dimethyl-3-(2-oxopropyl) cyclopropane acetic acid by transesterification.
Mitra, R.B., Joshi, B.N., Natekar, (Miss), M.V., Arabale, A.A. and Shinde, D.D.

30. 191/DEL/84
Preparations of substituted alkyl, cyclohexyl, cyclohexylalkylaryl, aralkyl esters of 2, 2-dimethyl-3-(2-oxopropyl) cyclopropane acetic acid and 2, 2-dimethyl-3-(n-propyl) cyclopropane acetic acid derived from (+) 3-carene as potential miticides by the reaction with thionyl chloride.
Mitra, R.B. Joshi, B.N., Natekar (Miss), M.V., Arabale, A.A. and Shinde D.D.

31. 506/DEL/84
A process for synthesis of 22, 23-dihydroxy-24S-ethyl-3 5 cyclo-5-cholestan-6-ones from phytosterols of sugarcane wax.
Mitra, R.B., Kapoor (Miss), V.M. and Hazra, B.G.

32. 507/DEL/84
An improved process for the preparation of monoalkyl esters, of azelaic acid.
Mitra, R.B., Joshi, R.S. and Lunkad, K.F.

33. 537/DEL/84
An improved process for the preparation of SYMN, N' disubstituted diarylurea compounds.
Ayyangar, N.R. and Choudhary, A.R.

34. 587/DEL/84
A novel process for the manufacture of 2, 4-dichloro-5-pentadecylphenoxy acetic acid.
Amarnath, N., Ghatge, N.D. and Moghe, P.P.

35. 664/DEL/84
Improvements in or relating to the preparation of 3-methyl-but-2-ene-YL acetate.
Mitra, R.B., Kulkarni, G.H., Joshi, R.S., Khanna P.N., Lunkad, K.F., and Shaha, S.C.

36. 837/DEL/84
A process for separation of stigmasterol derived products from phytosterols of sugarcane wax.
Mitra, R.B., Kapoor (Miss), V.M. and Hazra, B.G.

37. 60/DEL/85
Process for the preparation of new catalyst composite material useful for conversion of alkanols to hydrocarbons.
Ratnasamy, P., Kulkarni, (Miss), S.B., Kotasthane, A.N. and Shiralkar, V.P.

38. 61/DEL/85
Process for the preparation of a catalyst useful for selective conversion of ethylene into aromatic hydrocarbon containing 6-8 carbon atoms.
Ratnasamy, P., Kulkarni (Miss), S.B., Balakrishnan, I., Rao, B.S. and Shiralkar, V.P.

39. 224/DEL/85
Improvement in or relating to the process for the isolation of useful sterols from sugarcane wax.
Mitra, R.B. and Kapadia, V.H.

40. 251/DEL/85
A process for preparing base polymer for ion-exchange membranes.
Saini, R., Nadkarni, V.M., Dutta, A., Ghosh, S., Kshirsagar, S.N. and Mashelkar, R.A.

41. 267/DEL/85
A device for obtaining NMR spectra in undeuterated solvents on FT (fourier transform) instruments.
Deshpande, K.G.

42. * 279/DEL/85
Process for conversion of methanol to olefins.
Ratnasamy, P., Balakrishnan, I., Rajiv Kumar and Hegde, S.G.

43. * 430/DEL/85
Novel dispensors for controlled release of aquatic larvicides.
Sharma, R.N., Vartak, H.G., Gund, (Miss), P.D., Bhaldar, I.V., Rao, J.V., Pawar, V.K. and Mitra, R.B.

44. * 632/DEL/85
A process for the preparation of novel lanthanum iron silicates designated as Encilite-2.
Ratnasamy, P., Kulkarni (Miss), S.B., Shiralkar, V.P., Kotasthane, A.N. and Chandwadkar (Mrs.), A.J.

45. * 634/DEL/85
Improvements in or relating to the preparation of 3-acyloxy and 3-aroyloxy-isoxazole derivatives.
Mitra, R.B., Subba Rao, A., Ray, G.D., Toke, S.M. and Patil, S.G.

46. * 735/DEL/85
A process for the preparation of methyl (±)-cis-3, 3-dimethyl-2-formyl-cyclopropane-l-carboxylate.
Mitra, R.B., Muljiani (Miss), Z., Gadre (Mrs.), S, Joshi (Mrs.), V.

47. * 1051/DEL/85
A process for the preparation of novel geraniol based diethers useful as insect control agents.
Patwardhan (Mrs.), S.A., Sharma, R.N., Phadnis, A.P., Gund (Miss), P.D. and Bhaldar, I.V.

48. * 1053/DEL/85
A process for the preparation of novel geraniol based diethers useful as insect control agents.
Patwardhan (Mrs.), S.A., Sharma, R.N., Phadnis, A.P., Gund (Miss), P.D. and Bhaldar, I.V.

49. *1126/DEL/85
Process for the preparation of geraniol based saturated diethers useful as new insect control agents.
Patwardhan (Mrs.), S.A., Sharma, R.N., Phadnis, A.P., Gund (Miss), P.D. and Bhaldar, I.V.

50. *109/DEL/86
An improved process for the preparation of codeine from morphine.
Ayyangar, N.R., Choudhary, A.R., Kalkote, U.R. and Sharma, V.K.

51. *187/DEL/86
An improved process for the preparation of 2-bromo-1-phenylethanol.
Bhosale, S.S., Natekar (Miss), M.V., Joshi, P.L., Dixit, K.N. Vaidya, A.S. and Rao, A.S.

52. *195/DEL/86
Improvements in or relating to the process for the preparation of lactone of 2, 2-dimethyl-3- (2, 2, 2-trichloro-l-hydroxyethyl) cyclopropane carboxylic acid.
Mitra, R.B. Kulkarni, G.H. Khanna, P.N., Bhawal, B.M. and Deshmukh, A.R.A.S.

53. *196/DEL/86
Improvements in or relating to the process for the preparation of 1,1, 1-trichloro-4-methyl-pent-3-ene-YL diazoacetate.
Mitra, R.B. Kulkarni, G.H., Khanna, P.N., Bhawal, B.N. and Deshmukh, A.R.A.S.

54. *281/DEL/86
Improved process for the production of trichlorosilane (TCS) from silicon tetrachloride.
Neurgaonkar, V.G., Sinha, A.P.B., Srivastava, P.R., Phadnis, S.B. and Pires, J.A.

55. *282/DEL/86
A process for the preparation of crystalline aluminophosphate catalysts.
Ratnasamy, P, Kulkarni (Miss), S.B., Kamble (Mrs.), K.R. and Shiralkar, V.P.

* These applications were newly filed during the year.

Foreign patent application sealed.

1. U.K. Patent Application No. 7935813
New pyrethroid (corresponds to the Indian Patent Application No. 761/DEL/78-Synthesis of new insecticide belonging to the synthetic pyrethroids group)

Foreign Patent application filed.

1. Netherland Patent Application No. 7907332
Werkwijze on insecticiden uit de pyrethoide group to bereiden (corresponds to the Indian Patent Application No. 761/DEL/78-Synthesis of a new insecticide belonging to the synthetic pyrethroids group).
Mitra, R.B., Kulkarni, G.H., Gore, K.G., Muljiani (Miss), Z., Khanna, P.N., Joshi, G.D., Khanra, A.S. and Bhawal, B.M.
2. Algerian patent application No. 7124*
3. Australian patent application No. 30020/84*
4. East German Patent No. 232841 (appl. No. WBO 1J/2667853)*
5. East German patent application No. 01J/2860732/2 (Divisional to WBO 1J/266785)*
6. Egyptian patent application No. 763/84*
7. European patent No. 01601360 (appl. No. 84 302893.7)*(Designated countries : UK, France, West Germany, Belgium, Switzerland, Italy)
8. Indonesian patent application No. 10173*
9. Japanese patent application No. 44979/85*
10. Libyan patent application No. 2314*
11. Pakistan patent No. 129327 (appl. No. 251/84)*
12. USSR patent application No. 377, 3893.26*
13. USSR patent application No. 377, 0903.04*
14. Thailand patent application No. 2565*
15. Australian patent application No. 51247/85**
16. European patent application No. 85308747.6**
(designated countries : Belgium, West Germany, UK, France, Switzerland, Italy)
17. USSR patent application No. 4012815.04**
18. USA patent application No. 801682**

* These patent applicants correspond to Indian patent application Nos. 275/DEL/83 and 437/DEL/83.

** These patent applications corresponding to Indian patent application Nos. 60/DEL/85 and 279/DEL/85 were newly filed during the year.

RESEARCH UTILIZATION

TABLE 1 : PRODUCTS MANUFACTURED ON THE BASIS OF NCL KNOW-HOW

(T-Metric Tons)

Sl. No.	Name of the Process/product	Field of utilization	Name of the manufacturer (year of commencement of production)	Production Qty./value Rs. in lakhs in 1985-86	Upto March'85 Qty./value Rs. in lakhs	Capacity installed Nature of release and remarks
1	2	3	4	5	6	7
1.	Acetanilide	Intermediate	Hindustan Organic Chemicals Ltd., PO: Rasayani 410 207 (through project engineers R.L. Dalal & Co., Bombay 400 018) (1969)	2327.00 T 744.64	29996.49 T 5451.36	2000 T Non-exclusive
2.	Acrylic acid/ acrylates from acrylonitrile	Petrochemicals, bulk organic chemiclas	Indian Petrochemicals Corpn. Ltd., PO: Petrochemicals, Dist. Baroda 391346 (1984)	642.00 T 222.31	5306.00 T 1928.00	10,000 T sponsored
3.	Antipriming compositions	Antipriming in locomotives	Research Designs and Standards Organisation, M&C Wing, Lucknow 226011 (1964)	2.00 T 0.40	178.58 T 17.53	26 T Non-exclusive
4.	*t*ert-Butyl catechol	Synthetic rubber	Percynic Chemicals, Bombay Silk Mills Bldg., Industrial Estate, Lalbaug, Bombay 400 012 (1972)	6.8 T 8.5	95.2 T 107.29	50 T Non-exclusive
5.	Butyl titanate	Varnishes, enamels	Synthochem, 33 A, Laxmibaingar Indsutrial Estate, Indore 452 006 (1973)	31.90 T 24.88	322.00 T 172.13	36 T Non-exclusive
6.	Calcium hypophosphite	Pharmaceuticals	Hypophosphite & Co., 79-F, Princes Street, Bombay 400 002 (1967)	10.00 T 11.00	190.00 T 144.30	24 T (including hypophosphites) Sponosred
7.	Can lining composition	Metal can industry	Arya Chemical Works, 141/2 A, Lenin Sarani, Calcutta 700 013 (1974)	—	6.34 T 2.10	500 Kg/day Non-exclusive

1	2	3	4	5	6	7
8.	Can sealing composition	Metal can industry	-do- (1962)	—	587.41 T 44.92	500 Kg/day Non-exclusive
9.	Catechol	Pharmaceuticals	Percynic Chemicals, Bombay (1972)	8.20 T 4.92	98.01 T 59.12	50 T Non-exclusive
10.	Cation exchange resin-styrene DVB base	Demineralization of liquids	Bharat Process & Mechanical Engineers Ltd., Dakhindari, Calcutta 700 048 (1968-69)	—	28662.18Cft 98.39	10000 Cft Non-exclusive
11.	Chlorobenzenes (MCB)	Industrial chemicals	Hindustan Organic Chemicals Ltd., PO : Rasayani (1976)	5143.00 T 702.02	43386.41 T 4183.36	4500 T Sponsored
12.	Chloromethanes	Industrial chemicals	Standard Alkali Chemicals Divn., The Standard Mills Co. Ltd., Mafatlal Centre, Nariman Point, Bombay 400 021 (1974)	—	4020.12 T 171.44	3000 T —
13.	*Citrate plasticizers tributyl/acetyl tributyl citrate	Plasticizers	Citroflex P. Ltd., Neville House, Ballard Estate, Bombay 400 038 (1985)	664.00 T 116.00	—	Sponsored
14.	Diethyl-*m*-aminophenol	Dye Intermediate	Sahyadri Dyestuffs & Chemicals, Pune (1970)	—	808.03 T 939.45	150 T Sponosred
15.	Dihydroisojasmone and peach aldehyde	Perfumery chemicals	S.H. Kelkar & Co. Ltd., Lal Bahadur Shastri Marg, Mulund, Bombay 400 080 (1965)	—	61.62 T 21.07	2 T Non-exclusive
16.	Dimethoate	Pesticides	i) Mico Farm Chemicals Ltd., Lotus Court, 165, Thambu Chetty Street, Madras 600 001 (1979)	—	77.34 T 55.99	100 T Non-exclusive
			ii) Shaw Wallace & Co. Ltd., 4, Bankshall Street, Calcutta 700 001 (1979)	248.37 T 144.15	40.95 T 32.62	150 T Non-exclusive

1	2	3	4	5	6	7
17.	Dimethylaniline (continuous process)	Industrial chemicals	Navin Chemicals, C/o Sahyadri Dyestuffs & Chemicals, Divn. of Deepak Nitrite Ltd., Pune 411 030(1976)	610.20 T 230.21	2450.18 T 761.86	3000 T Sponsored
18.	Endosulfan	Pesticides	Bharat Pulverising Mills Pvt. Ltd., Shriniketan, 14 Queens Road, Bombay 400 020 (1980)	—	24.16 T 20.54	600 T Non-exclusive
19.	Ethion	Pesticides	Shaw Wallace & Co. Ltd., Calcutta (1979)	120.00 T 86.77	33.06 T 26.24	100 T Non-exclusive
20.	Ethylenediamine	Bulk organic chemicals	Diamines & Chemicals Ltd., The Bharat Vijay Mills Ltd. Premises, Kalol 382 721 (1982)	1215.00 T 701.00	78.00 T 31.00	2000 T (Ethylenediamine and polyamines)
21.	Ethylene oxide condensates	Surface active agents	Hico Products Ltd., 771, Mogal Lane, Mahim, Bombay 400 016 (1965)	2392.00 T 855.55	25012.14 T 6393.67	2500 T Sponosred
22.	Ferrites-Hard	Electronics	Dr. Shet Magnetics P. Ltd., 1069, V Block, 1st floor, Rajaji Nagar, Bangalore 560 010 (1978)	N.A. 0.10	4.00 T 5.08	20 T Non-exclusive
23.	4-Hydroxycoumarin	Pharmaceutials	Unichem Laboratories Ltd., Unichem Bhavan, S.V. Road, Bombay 400 060 (1974)	—	273.69Kg 1.06 (including warfarin)	540 Kg Non-exclusive
24.	Ibuprofen	Drug	The Chemical Industrial & Pharmaceutical Laboratories Ltd. (CIPLA), Bombay 400 008 (1983)	Reported to be in production Data not available		
25.	Immobilized enzyme	Pharmaceutical	Hindustan Antibiotics Ltd., Pimpri, Pune 411 018	700 Kg N.A.	1880.00 Kg N.A.	Captive consumption

1	2	3	4	5	6	7
26.	β-Ionone	Perfumery, intermediate for vitamin A	S.H. Kelkar & Co. Ltd., Bombay (1975)	767.00 Kg. 3.87	2.092 T 8.42	4.4 T Non-exclusive
27.	Maleic hydrazide	Agrochemical	Micro Chemicals (India), Scheme No. 1, Road No. 3, Nai Abadi, Mandsaur 458 001 (1978)	—	2.22 T 1.24	1 T Non-exclusive
28.	p-Menthane hydroperoxide	Synthetic rubber	Camphor & Allied Products Ltd., PO: Clutterbuckganj 243 502, Dist. Bareilly (1976)	30.28 T 43.65	200.72 T 89.99	60 T Exclusive
29.	Methyl chlorosilane	Intermediate	Hico Product Ltd., Bombay (1983)	150.00 T 80.94	1078.00 T 424.00	Collaborative Non-exclusive
30.	Monochloro acetic acid	Intermediate for weedicides, carboxymethyl cellulose, etc.	Hico Products Ltd., Bombay (1975)	356.00 T 71.20	3387.37 T 517.78	720 T Non-exclusive
31.	Monoethylaniline	Intermediate for explosive	The Atul Products Ltd., Atul 396 020, Dist. Valsad (1975)	—	865.21 T 306.40	100 T Non-exclusive
32.	1-Naphthyl acetic acid	Agro chemicals, Plant growth regulator	Micro Chemicals (India), Mandsaur (1975)	—	5.10 T 5.10	1.5 T Sponosred
32.	Nicotine sulphate from tobacco and tobacco waste	Insecticides	Urvakunj Nicotine Industries, Petlad Cambay Road, Dharmaj 388 430, Dist. Kaira (1963)	—	1741.61 T 640.5	150 T Non-exclusive
34.	Nitrile rubber	Oil resistant rubber, formulations, adhesives	Synthetics and Chemicals Ltd., 7, Jamshedji Tata Road, Bombay 400 020 (1974)	137.32 T 22.95	5942.02 T 978.06	2000 T

1	2	3	4	5	6	7
35.	p-Nitrophenol	Intermedaite	Hindustan Organic Chemicals Ltd., PO : Rasayani (1978)	—	4.00 T 1.16	900 T Non-exclusive
36.	Nonylphenol	Surface active agent	Aniline Dyestuffs and Pharmaceuticals Pvt. Ltd. Mahalaxmi Chambers, 22 Bhulabhali Desai Road, Bombay - 400 026. (1974)	—	178.73 T 25.31	1000T sponsored
37.	Opium alkaloids	Pharmaceuticals	Govt. Opium & Alkaloid Works Undertaking, Neemuch 458 441 (1975)	—	54.89 T 281.76	16.66 T of various alkaloids (morphine codeine, narcotine, papavarine & thebaine) Exclusive
38.	Perfumery products based on longifolene (capinone)	Perfumery	Comphor & Allied Products Ltd., Dist. Bareilly (1968)	—	205.87 T 298.65	50 T (for both capinone and meracene) Sponsored.
39.	Perfumery products based on △3 carene (meracene)	Perfumery	-do-		129.18 T 71.70	-do-
40.	β -Phenethyl alcohol	Perfumery	Sunanada Aromatic Industries, Mysore-K.R.S. Road, Mettagalli P.O. Mysore 571 106 (1970)	—	1072.83 T 603.13	270 T Sponsored
41.	Phenthoate	Insecticides	Bharat Pulverising Mills Pvt. Ltd., Bombay (1975)	—	27.10 T 17.55	600 T Sponsored
42.	Phthalate-butyl octyl	Plasticizers	Herdillia Chemicals Ltd., Air India Bldg., Nariman Point, Bombay 400 021	—	317.43 T 59.77	5000 T (including other phthalates) Non-exclusive

1	2	3	4	5	6	7
43.	Phthalates-diethyl and dimethyl	Plasticizers	The Mysore Acetate and Chemicals Co. Ltd., A-19, Acetate Town, Mandya 571 404 (1970)	321.00 T 80.25	3138.71 T 545.77	600 T Non-exclusive
44.	Phthalates-dioctyl and dibutyl	Plasticizers	Amines and Plasticizers Ltd., 'D' Bldg., Shiv Sagar Estate, Dr. Annie Besant Road, Worli, Bombay 400 018 (1971)	2439.91 T 643.94	49833.18 T 8164.55	5000 T Non-exclusive
45.	Polyurethane coating	Coatings	Cipy Chemicals, 229, Rasta Peth, Pune 411 011 (1977)	1708.00 Lt. 0.84	12946.00 Lt. 5.25	30 T Non-exclusive
46.	Polyurethane printing rollers	Printing	Sree Saraswathy Press Ltd., 32, Acharya, P.C. Ray Rd., Calcutta 700 009 (1965)	—	662 Nos. 14.25	3000 Nos. Non-exclusive
47.	Quinapyramine sulphate/chloride	Veterinary drugs	Chintamani Fine Chemicals, S. No. 64/5, Bhide Baug, PO Vadagaon Budruk, Sinhagad Road, Pune 411 041 (1982)	—	149.00 Kg 12.05	N.A. Non-exclusive
48.	Radiosonde thermistors	Meteorology	The Bhagyanagar Laboratories, 11-1523/8, Golkonda Cross Rd., Hyderabad (1974)	—	215000 Nos. 38.79	N.A. Non-exclusive
49.	D.C. Recording polarograph including potentiometric strip chart recorder for captive consumption	Polarographic analysis	Elico Pvt. Ltd., Santnagar Indl. Estate, Hyderabad 500 018 (1974)	-	195 + 3 Units 30.46	50 Units Non-exclusive
50.	Silica gel	Humidity control	Minco Products, 17, Thirwottyur High Road, Madras 600 081 (1963)	12.00 T 2.00	4988.20 T 23.32	18 T Sponsored

1	2	3	4	5	6	7
51.	70% Sorbitol from dextrose monohydrate	Pharmaceuticals, Vitamin C synthesis	i) Maize Products, Divn. of Sayaji Mills Ltd., PO Kathawada, Maize Products, Ahmedabad 382 430 (1976)	2291.76 T 375.09	12641.12 T 911.81	2000 T Non-exclusive
			ii) The Anil Starch Products Ltd., P.B. No. 10009, Anil Rd., Ahmedabad 380 025 (1976)	495.00 T 52.60	5011.40 T 541.16	1000 T Non-exclusive
52.	Sorbitol from glucose (continuous process)	Pharmaceutical	The Anil Starch Products Ltd., Ahmedabad 380 025 (1985)	1074.00 T 155.35	1074.00 T 155.35	Sponsored
53.	Direct reading spectrophotometer/ calorimeter	Biochemical research, spectroscopic analysis in visible range	Scientific Instruments Co. Ltd., Tej Bahadur Sapru Rd., Allahabad 211 001 (1974)	19 Nos. 1.5	242 Units 16.64	100 Units Non-exclusive
54.	Staple pin adhesive	Adhesive for staple pins	Esdee Paints, Near Power House, Kolshet Rd., Thane 400 607 (1979)	1608.00 Lt 1.06	8321.00 Lt 5.26	N.A. Non-exclusive
55.	Terpineol	Perfumery	Dujodwala Industries, Ltd., Tulsiani Chamebrs, 212, Nariman Point, Bombay 400 021 (1976)	—	400.00 T 112.50	200 T Non-exclusive
56.	p-Toluidine from p-nitrotoluene by vapour phase reduction	Organic intermediate	Sudarshan Chemical Industries, 162, Wellesley Road, Sangam Bridge, Pune 411 001 (1977)	59.00 T 32.72	820.00 T 328.11	300 T Sponsored
57.	Trichlorobenzene	Intermediate	Mycol International Agencies, Lotus Court, 165, Thambu Chetty St., Madras 600 001 (1978)	—	2.30 T 0.16	100 Kg/batch Non-exclusive

1	2	3	4	5	6	7
58.	Vinblastin sulphate B.P. and Vincristine sulphate B.P.	Pharmaceuticals	The Chemical & Pharmaceutical Laboratories Ltd., Bombay (1984)	Reported to be in production Data not available		N.A. Non-exclusive
59.	Vitamin C	Pharmaceuticals	Hindustan Antibiotics Ltd., Pimpri, Pune 411 018 (1975)	—	5.83 T 7.82 (Estimated)	125 T Non-exclusive
60.	Warfarin	Rodenticide	Unichem Laboratories Ltd., Bombay (1974)	—	384.29 Kg	840 Kg. Non-exclusive

VALUE OF PRODUCTION BASED ON NCL TECHNOLOGIES

Year	No. of items manufactured	Value of production (Rs. in lakhs)
1981-82	62	2928.62
1982-83	58	3019.11
1983-84	58	3685.16
1984-85	60	4703.84
1985-86	60	5251.80
		19588.53

SECTORWISE VALUE OF PRODUCTION OF NCL TECHNOLOGIES (1985-86)

Type of industry	No. of processes in production	Value of production during 1985-86 (Rs. in lakhs)
1. Public Sector	5	1669.37
2. Large scale private sector	22	3528.27
3. Medium and small scale sector	33	54.16
	60	5251.80

TABLE II PROCESSES RELEASED AND AWAITING PRODUCTIONS

Sr. No.	Name of the process	Field of utilisation	Name of the party (Year of release)	Nature of release	Remarks
1	2	3	4	5	6
1.	Adhesive from renewable resources	Adhesive	Carborundum Universal Ltd., 28, Rajaji Road, Madras 600 001 (1985)	Sponsored	Recently released
2.	Aniline	Organic intermediates	Hindustan Organic Chemicals Ltd., Rasayani (1973)	Non-exclusive	—
3.	Anisidine by liquid phase hydrogenation of nitroanisoles	Intermediate for dyestuffs	Amar Dye-Chem Ltd., Rang Udyan, Sitladevi Temple Rd., Mahim, Bombay 400 016 (1974)	Sponsored	—
4.	Antioxidant TEDO (2,2,4-trimethyl-6-ethoxy-1,2-dihydroquinoline	Rubber	-do- (1976)	Non-exclusive	—
5.	Atrazine	Herbicide	-do- (1978)	-do-	—
6.	Butenediol	Pesticides, polymers	Hindustan Organic Chemicals Ltd., Rasayani (1980)	Collaborative work	—
7.	1,3-Butylene glycol	Petrochemicals, bulk organic chemicals	Indian Petrochemicals Corpon. Ltd., Dist. Baroda (1976)	Sponsored	—
8.	Butyl titanate	Varnishes, enamels	i) Monopol Chemicals Pvt. Ltd., 901, Rahaja Chambers, Nariman Point, Bombay 400 021 (1984-85)	Non-exclusive	Recently released
			ii) Super Urecoat Industries Pvt. Ltd., F-11, Behind Nac Tiles, GIDC, Naroda 382 330 (1985)	-do-	-do-

1	2	3	4	5	6
9.	Camphene from pinene	Pharmaceuticals, perfumery	Resin & Terpene Industries, 812/813, Tulsiani Chambers, 212, Nariman Point, Bombay 400 021 (1978)	Sponsored	—
10.	Carboxin	Pesticides	i) Bharat Pulverising Mill P. Ltd., Bombay (1978)	Non-exclusive	Under implementation
			ii) Laxmi Traders, 2 India Exchange Place, Calcutta 700 001 (1980)	-do-	-do-
11.	Conversion of crotonaldehyde to maleic anhydride	Intermediate	Deccan Sugar Institute, Manjari, Pune 412 307 (1983-84)	Sponsored	Under implementation
12.	Carboxylation of ethanol to propionic acid	Intermediate	Deccan Sugar Institute, Manjari, Pune 412 307 (1983-84)	Sponsored	Recently released
13.	Catalytic vapour phase oxidation of toluene to benzaldehyde	Intermediates for pharmaceuticals, perfumeries, etc.	Indian Organic Chemicals Ltd., Khopli 410 203 Dist. Raigad (1981)	Sponsored	—
14.	Chloroquin phosphate	Drug intermedaites	Sudarshan Chemical Industries Ltd., Pune (1985)		
15.	Clonal multiplication of cardamom by tissue culture	Agriculture	i) A.V. Thomas & Co., 22, Marshells Rd., Egmore, Madras 600 008 (1984-85)	Non-exclusive	Recently released
			ii) Cardamom Research Institute, Cardamom Board, Banerji Road, Cochin 682 018 (1984)	-do-	-do-
			iii) R.B. Thakur & Co. Pvt. Ltd., Clerk House, 8, Wade House Road, Bombay 400 039	-do-	-do-
16.	Dapson	Drug	CIPLA, Bombay (1984)	Sponsored	—

1	2	3	4	5	6
17.	Dextropropoxyphene hydrochloride	Drug	Centaur Laboratories, Kumar Engg. compound, Kalina, Santacruz (East), Bombay 400 029 (1983-84)	Sponsored	—
18.	Diazepam	Anti-anxiety drug	Orion Chemicals, Mulchand Mansion, Princes St., Bombay 400002 (1975)	Non-exclusive	
19.	Dibutyl tin oxide	PVC stabilizers	Dura Chemical Corpn. Ltd., Wakefield House, 11, Sprott Rd., Ballard Estate, Bombay 400 038 (1977)	Non-exclusive	Under implementation
20.	Dichloropropionic acid (Dalapon)	Pesticides	i) Hico Prdoucts Ltd., Bombay (1975)	Non-exclusive	—
			ii) Jaydee Agrochemicals P. Ltd., Majwaji Ka Bagh, Moti Dugri Road, Jaipur 302 004 (1975)	Non-exclusive	—
21.	Dimethoate	Pesticides	PNM Company, Thindal, Perundurai Main Road, Erode 638 009 (1978)	-do-	-do-
22.	Doxepin	Drugs	Pharmaceuticals Company of India (PCI), 301, Arun Chambers, J. Dadajee Road, Tardeo, Bombay (1985)	Sponsored	—
23.	Drag reducers for oil transportation	Petroleum industry	Oil Industry Development Board, New Dedlhi (1985)	Non-exclusive	—
24.	DVO acid chloride	Intermediate	National Organic Chemical Industries Ltd., Mafatlal, Centre, Nariman Point, Bombay 400 021	-do-	-do-

1	2	3	4	5	6
25.	Endosulfan	Pesticides	Hindustan Insecticides Ltd., Hans Bhavan, Wing I, Bahadur Shah Zafar Marg, New Delhi 110 002 (1976)	-do-	Turn-key plant offered through project Engrs; in trial Prodn.
26.	Ethephon	Pesticides	i) Varson Chemicals Pvt. Ltd., 9th Mile, Hosur Rd., PO: Singasanda, Bangalore 560 068 (1978)	Non-exclusive	—
			ii) Sudarshan Chemical Industries Pvt. Ltd., Pune (1984-85)	-do-	—
			iii) Hycount Agro, Sherry Land, Quilon 691 005 (1984-85)	-do-	—
27.	Eucalyptus tereticornis by tissue culture		A.V. Thomas & Co., Madras (1985)	-do-	Direct release CSIR/NCL
28.	Flematic skin oil	Veterinary drugs	TTK Pharma P. Ltd., Old Trunk Road, Madras 600 043 (1984)	Non-exclusive	—
29.	Flexible magnets	Refrigeration gaskets,toys, educational kits	Dr. Shet Magnetics P. Ltd., Bangalore (1976)	Non-exclusive	—
30.	Hexachlorocyclo-pentadiene (HCCP)	Pesticides	Hindustan Organic Chemicals Ltd., Rasayani (1981)	Collaborative work	—
31.	IR spectrophotometer	Analysis	Dept. of Science & Technology, New Delhi (1985)	Sponsored	—
32.	Items having short shelf life	Sealants, adhesives	Hindustan Aeronautics Ltd. (Nasik Divn.), Ozar Townshop PO, Nasik 422 007 (1980)	-do-	Recently released

1	2	3	4	5	6
33.	Ketoprofen	Drug	Pharmaceuticals Company of India (PCI), Bombay (1985)	-do-	—
34.	1-Menthol from △3 carene	Perfumery	Bhavana Chemicals Ltd., Laxmi Insurance Bldg., Sir P.M. Rd., Bombay 400 001 (1978)	-do-	Under implementation
35.	Morpholine	Intermediate for rubber chemicals	i) Bombay Wire Ropes Ltd., Kavesar Village, Ghodbunder Road, Thane (1975)	Non-exclusive	—
			ii) Catalyst (India) P. Ltd., Embassy Centre, 10th floor, 207, Backbay Reclamation, Narman Point, Bombay 400 021 (1975)	-do-	—
36.	Multiplication of Napier grass by tissue culture	Agriculture	National Organic Chemical Industries Ltd., Mafatlal Centre, Bombay 400 021 (1983-84)	Sponsored	-
37.	Multiplication of teak by tissue culture	Foresty	Forest Development Corpn. of Maharashtra Ltd., 6-A, Nawab Layout, Tilak Nagar, Nagpur (1981)	Sponsored	Under field trials
38.	Necelon	Perfumery	Comphor & Allied Products Ltd., 133, M.G. Road, Jehangir Bldg., Bombay 400 023 (1984-85)	Non-exclusive	Recently released
39.	Nicotine sulphate	Insecticides	Kraun Fine Chemicals P. Ltd., Chikodi, Karnataka (1983-84)	-do-	—
40.	Nitrofen	Weedicide	Amar Dye-Chem Ltd., Bombay (1978)	Non-exclusive	—
41.	p-Nitrophenol	Intermediate	Catalyst (India) P. Ltd., Bombay (1975)	-do-	—

1	2	3	4	5	6
42.	Phenylglycyl chloride	Drug intermediate	Sudarshan Chemical Industries Ltd., Pune (1983-84)	Sponsored	Recently released
43.	Polysulphide liquid rubber	Adhesives, sealants	i) Rathi Rubber Products, 27, Shankarshet Road, Pune 411 009 (1981)	Non-exclusive	—
			ii) Mundoz Corporation, 3, Moghe Bhuwan, Gokhale Rd., Bombay 400 028 (1981)	-do-	—
			iii) Transpeck Industry Ltd., Vadodara (1983-84)	-do-	Recently released
44.	Polysulphide sealant compound (Sp. by HAL, Nasik)	Sealants	Rathi Rubber Products, Pune (1981)	Non-exclusive	—
45.	Polyurethane coating	Coating	Simple Coatings, Fahmeeda Manzil, Bhoipura, Bhopal (1984-85)	-do-	Recently released
46.	Propylene oxide from propylene (extention to propylene glycol)	Petrochemicals	Indian Petrochemicals Corpn. Ltd., Dist. Baroda (1978)	Sponsored	—
47.	Silver paste for mica capacitor electrodes	Electronics	Luxmi Traders, Calcutta (1981)	Non-exclusive	—
48.	Simazine	Herbicide	Amar Dye-Chem Ltd., Bombay (1978)	-do-	—
49.	Sodium sulphide	Various industries	-do- (1976)	(Technical aid)	—
50.	Sodium and potassium ferrocyanides	Industrial chemicals	Hindustan Development Corpn. Ltd., Kanchanganga, 7th floor, 18, Barakhamba Road, New Delhi (1985)	Non-exclusive	—

1	2	3	4	5	6
51.	Staple pin adhesive	Adhesive for staple pins	Duro Meto Chem. P. Ltd., Nirlon HOuse, 254-B, Dr. A.B. Road, Worli, Bombay 400 025 (1976)	Non-exclusive	—
52.	Substitute for side seam cement	Adhesive	Nand Industries, 324,Shaniwar Peth, Pune 411 030 (1978)	Sponsored	—
53.	Sulphur monochloride	Industrial chemical	Phosphate Co. Ltd., 14, Netaji Subhash Road, Calcutta 700 001 (1976)	Non-exclusive (Technical aid)	—
54.	Synthesis of basic drugs and intermediates	Drug intermediates	Dexo Laboratories P. Ltd. , 6-3-348 Dwarkapuri colony, Hyderabad 500 004 (1984-85)	Sponsored	Recently released
55.	Theophylline, aminophylline and caffeine	Pharmaceuticals	i) Pefco Foundry & Chemicals Ltd., Plot No. 10, off Dr. Moses Road, Worli, Bombay 400 018 (1978)	Non-exclusive	In trial prodn.
			ii) Nufarm Chemicals,Faridabad (1984-85)	Non-exclusive	Recently released
56.	Thionyl chloride	Various industries	Dharamsi Morarji Chemicals Ltd., Prospect Chambers, 317/21, Dr. D.N. Road, Bombay 400 001 (1977)	Collaborative work	—
57.	Toluene disproportionation and transalkylation	Petrochemicals	Indian Petrochemicals Corpn. Ltd., Baroda (1985)	Sponsored	—
58.	Vitamin B_6	Drugs	i) Lupin Laboratories, 159, CST Road, Kaline, Santacruz (E) Bombay 400 098 (1983-84)	Non-exclusive	Recently released
			ii) Themis Chemicals, Plot No. 69, GIDC, Vapi, (Dist. Valsad), Gujarat	Non-exclusive	—

* These process have also appeared in Table I along with other licensees.

LIST OF PROCESSES AVAILABLE
(As in Sept. 1987)

Sr. No.	Name of the process/ product	Field of utilisation	Major Raw materials	Range of total capital requirement	Remarks
1	2	3	4	5	6
1.	Acetanilide	Drug and dye intermediate	Aniline and acetic acid	C	Released, in production, turn-key plant available through project engineers
2.	Aniline	Organic intermediate	Nitrobenzene, hydrogen and catalyst	C	Released
3.	Atrazine	Herbicide	Cyanuric chloride, ethylamine and monoisopropylamine	C	Released
4.	*tert*-Butyle catechol	Stabilizer and poly merization inhibitor for synthetic rubber	Catechol, tertbutyl alcohol and catalyst	A	Released, in production
5.	Butyl titanate	Insulating varnish, special paints, catalyst	Butanol and titanium tetrachloride	B	Released, in production
6.	Can lining composition (based on nitrile rubber)	Lining cans for storing mineral oils, greases, food	Synthetic rubber latex synthetic resins and rubber chemicals	A	Released, in production
7.	Can sealing composition(based on natural rubber)	Metal can industry	Natural rubber latex and rubber chemicals	A	Released, in production
8.	Carboxin	Pesticide	Acetoacetanilide, sulphuryl chloride, benzene and 2-mercaptoethanol	C	Released
9.	Cardmom by plant tissue culture	Agriculture		—	—
10.	2-Chloroethyltrimethyl ammonium chloride	Plant growth regulator	Trimethylamine and ethylene	A	

A — Capital requirement less than Rs. 10 lakhs
B — Capital requirement between Rs. 10 lakhs & Rs. 20 lakhs
C — Capital requirement above Rs. 2[illegible]lakhs
These figures are tentative and purely indicative, and are subject to revision from time to time.

1	2	3	4	5	6
11.	Diazepam	Anti-anxiety drug	p-Nitrochlorobenzene, benzyl cyanide, dimethyl sulphate, iron powder and chloroacetyl chloride	A	Released
12.	Dichloropropionic aicd (Dalapon)	Weedicide	Propionic acid, chlorine and soda ash	C	Released
13.	Dimethoate	Pesticide	Phosphorous pentasulphide, methanol, monochlo-roacetic acid, methyl amine and caustic lye	C	Released, in production
14.	Endosulfan	Pesticide	Hexachlorocyclopent-adiene, butenediol, thionyl chloride and epichlorohydrin	C	Released, process available on turn-key basis through project engineers
15.	Ethylenediamine	Bulk organic chemical	Ethylene dichloride, ammonia and caustic soda	C	do
16.	Ethephon	Pesticide	Phosphorus trichloride, ethylene oxide hydrochloric acid and sulphuric acid	A	Released
17.	Ethion	Pesticide	Phosphorus pentasul-phide, ethyl alcohol, dibromomethane and caustic soda	C	Released, in production
18.	Eucalyptus by plant tissue culture	Forestry	—	—	—
19.	Ferrites-Hard	Electronics	Iron oxide, barium carbonate, additive and binder	B	Released, in production
20.	Gaskets from cork granules	Gaskets	Cork granules, nitrile rubber and rubber chemicals	A	Released
21.	Maleic hydrazide	Plant growth regulator	Maleic anhydride and hydrazine hydrate	A	Released, in production
22.	Methylchlorosilanes	Basic material for silicon	Ferrosilicon and methyl chloride	C	Released, in production

1	2	3	4	5	6
23.	Microfilters	Industrial filtration.	Pulp, melamine and formaldehyde	A	Released
24.	Monochloroacetic acid	Intermediate for weedicides, carbonxy-methylcellulose, etc.	Acetic acid, chlorine and catalyst	B	Released, in production
25.	Monochlorobenzene	Bulk organic chemicals	Benzene and chlorine	C	Released
26.	Necelone	Perfumery	Longifolene	A	Released
27.	Nicotine sulphate from tobacco and tobacco waste	Insecticide	Tobacco/tobacco waste, lime, kerosene and sulphuric acid	A	Released, in production
28.	P-Nitrophenol	Intermediate for parathion and paracetamol	P-Nitrochlorobenzene, sodium hydroxide lye and hydrochloric acid	C	Released, in production
29.	Phthalate-butyl octyl	Plasticizer in non-electrical application	Phthalic anhydride, butyl alcohol and 2-ethyl hexanol	C	Released, in production
30.	Phthalates-dibutyl/dioctyl	Plasticizers	Phthalic anhydride and butyl alcohol/ethyl hexanol	C	Released, in production
31.	Phthalates-dimethyl/diethyl	Plasticizers	Phthalic anhydride and methyl/ethyl alcohol	C	-do-
32.	D.C. Recording polarograph	Polarographic analysis	Component parts and boxes	A	-do-
33.	Polysulphide liquid rubber	Adhesives, sealants, etc.	Ethylene chlorohydrin, p-formaldehyde, sodium sulphate, sulphur, sodium hydroxide and iron sulphide	A	
34.	Polyrethane coating	Coating for leather, rubber wood, glass etc.	Castor oil, toluene-diisocyanate and solvents	A	Rleased, in production
35.	Polyurethane printing rollers	Printing rollers	Castor oil, polyethylene glycol and toluene–diisocyanate	A	-do-

1	2	3	4	5	6
36.	Quinapyramine sulphate and chloride	Veterinary drug	p-aminoacetanilide, ethyl acetoacetate, ammonium acetate, dimethyl sulphate and guanidine carbonate	C	Released
37.	Radiosonde thermistors	Meteorology	Metallic oxides, platinum foil and components	A	Released, in production
38.	Rubber blowing agent	Rubber chemicals	Hexamine, sodium nitrite, hydrochloric, acid and stabilizers	A	Released
39.	Rubber reclaiming agent	Rubber chemicals	Xylene and sulphur monochloride	A	Released
40.	Silica gel (desiccant type)	Humidity control	Sodium silicate and sulphuric acid	A	Released, in production
41.	Silicon tecrachloride	Industrial chemi-chemical	Ferrosilicon, chlorine and hydrochloric acid	C	—
42.	Silver paste for mica capacitor electrodes	Electronic industry	Silver nitrate, acetone, caustic soda glass and filler	A	Released
43.	Simazine	Herbicide	Cyanuric chloride and ethylamine	C	Released
44.	70% Sorbitol from dextrose monohydrate	Pharmaceuticals and Vitamin C synthesis	Dextrose monohydrate, hydrogen and catalyst	C	Released, in production
45.	Sorbital (continuous process)	Pharmaceticals	Dextose monohydrate	C	Released
46.	Direct reading spectro-photometer/colorimeter	Biochemical research and spectroscopic analysis in visible range	Components and boxes	B	Released, in production
47.	Sodium & Potassium ferrocyanide	Pigments and textiles	Sodium cyanide/ ferrous sulphate	A	Rleased
48.	Staple pin adhesive	Adhesive for staple pins	Synthetic resin and solvent	A	Released
49.	Sugarcane by plant tissue culture	Agriculture	—	—	—

1	2	3	4	5	6
50.	Terpineol	Perfumery	Turpentine oil	B	Released (pilot plant available with NRDC)
51.	Theophylline, amino-phylline and caffeine	Drugs (cuffeins also used in beverages)	Dimethylures, monochloroacetic acid, acetic anhydride	C	Released
52.	Thermistors	Temperature measurement and control electronic devices	Oxides of high purity components and binder	A	Rleased, in production
53.	Trichlorobenzene	Intermediate	Non-gamma BHC residue and caustic lye	B	Released, in production
54.	Turmeric by plant tissue culture	Agriculture	—	—	—
55.	Vinblastin sulphate & Vincristine sulphate	Drug	Vinca rosea leaves	C	Released
56.	Vitamin B_6	Drug	—	A	Released
57.	Xanthates-Potassium ethyl and potassium amyl	Forth-floation	Ethyl/amyl alcohol, potassium hydroxide and carbon disulphate	A	Released

DATA ON NCL EXPENDITURE, RECEIPTS AND ACHIEVEMENTS
(1984-85 AND 1985-86)

	1984-85	1985-86
EXPENDITURE (Rs. in lakhs)		
1. Recurring	340.88	424.04
2. Capital	156.61	190.25
3. Pilot Plant	5.00	6.00
	502.49	620.29
RECEIPTS (Rs. in lakhs)		
1. Receipts on account of sponsored projects	7.02	6.61
2. Analytical/testing charges	1.10	1.16
3. Institutional consultancy (CSIR share) including know-how fee/job work	5.22	5.47
4. Sale of laboratory products	0.24	0.45
5. Miscellaneous receipts	15.71	13.51
	29.29	27.20
ACHIEVEMENTS		
1. Total number of processes in production	60	60
2. Value of production based on NCL know-how (Rs. in lakhs)	4703.84	5251.80
3. Estimated saving in foreign exchange on account of above production (Rs. in lakhs)	1881.53	2100.72
4. Total number (cumulative) of processes released and awaiting production		
(a) NCL processes	20	33
(b) Sponsored schemes	29	22
(c) Collaborative work	4	3
5. Total number of parties who have taken NCL processes for exploitation	161	167
6. Total number of parties who have sponsored processes	99	106
7. Total number of processes available for commercial exploitation	58	57
8. Number of processes released during the year		
(a) NCL processes	9	4
(b) Sponsored processes completed/concluded	6	8
9. Papers published	237	285
10. Papers presented/read at symposia, seminars, etc.	61	40
11. Doctorate and Master degrees received by NCL staff	(1983-85) 70	42
12. No. of recognised guides for Doctorate and Masters degrees	48	55
13. Patents in force	76	79
(a) In India	17	19
(b) Abroad		
14. Premia and Royalties received by NRDC through NCL processes (Rs. in lakhs)	—	0.75
(a) Premia	1.86	3.6
(b) Royalties		

CUMULATIVE DATA (1950-86)

EXPENDITURE (Rs. in lakhs)

1.	Recurring	3476.50
2.	Capital**	1504.99
3.	Pilot plant	96.94
		5078.26

RECEIPTS (Rs. in lakhs)

1.	Total money receipts	
	(a) Total premia earned by NRDC through NCL processes	52.34
	(b) Total royalties earned by NRDC through NCL processes	55.63
	(c) Total receipts from sponsored	125.01
	(d) Miscellaneous receipts including CSIR share of consultancy, analytical and testing charges, sales of laboratory products, job work and other receipts	197.02
		430.00

ACHIEVEMENTS

1.	Total value of production based on NCL knowhow (Rs. in lakhs)	33162.17
2.	Total No. of papers published	4428
3.	Total No. of papers presented/read at symposia, seminars	435
4.	Total No. of degrees received	661

**This figure does not include capital expenditure on NCL buildings amounting to Rs. 30.76 lakhs that was incurred by CSIR during 1949-50.

NCL EXECUTIVE COMMITTEE

(1-10-84 to 31-12-87)

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4.	Prof. G.S.R. Subba Rao, Chairman, Department of Organic Chemistry, Indian Institute of Science, Bangalore 560 012	Member
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7.	Dr. S.H. Iqbal, Scientist, National Chemical Laboratory, Pune 411 008	Member Secretary
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