ANNUAL REPORT
1997-98

वार्षिक प्रतिवेदन

CENTRAL SALT & MARINE
CHEMICALS RESEARCH INSTITUTE
BHAVNAGAR 364002

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केन्द्रीय नमक व समुद्री रसायन अनुसंधान संस्थान, भावनगर
CENTRAL SALT & MARINE CHEMICALS RESEARCH INSTITUTE
Bhavnagar 364002

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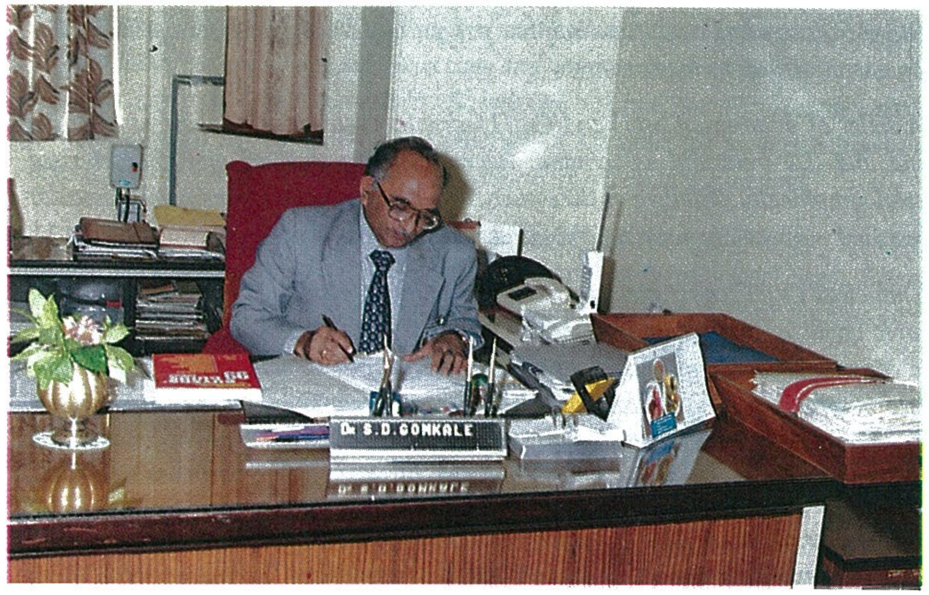


DIRECTOR'S REPORT

Central Salt & Marine Chemicals Research Institute (CSMCRI) is one of the smaller laboratories in the CSIR chain thriving for excellence in the areas of Inorganic Chemicals, Membrane Science & Technology and Biosalinity. The thrust was mainly towards deriving benefits to the economy and society by developing indigenous technology. However, in the changed scenario of economic liberalisation and globalisation it has become imperative to become competitive besides being active in areas of societal developments. Thus as in the past few years, during the period of this report also, CSMCRI has seriously endeavored to move in this direction as envisaged in the CSIR's strategy evolved to cope with the demands of globalisation and opening of the economy, simultaneously providing thrusts to meet the need of societal development. Sustained efforts in this direction has enabled us to succeed in enhancing interaction with industry, even though much is yet to be done. Against this background, the Institute has succeeded in its pursuit of good quality research. While details are presented elsewhere in the report, a resume of major achievements during the period is presented below.

In Salt & marine Chemicals solar evaporation studies of sub-soil brines from three different locations of Gujarat were taken up. The experimental data evolved can be utilized for recovery of high quality salt from sub-soil brines in situ.

The feasibility report for producing high quality salt by solar evaporation of sea water followed by salt washing in Qatar was prepared. For recovery of good quality salt from sub-soil brine available at Jambusar (Bharuch) a method for the production of consistent quality salt was suggested under a consultancy assignment

A feasibility report on salt refinery and washery was prepared for M/s. Hindustan Salts Limited, Sambhar. The report provides information regarding the techno-economic feasibility of salt refining using salt washery with a capacity of 1 lakh tpa.

Recovery of inorganic salts from saline water from water logged areas in the stage-1 of Indira Gandhi Nahar Pariyojana (IGNP) was studied as a sponsored project

In the Silicates and catalysis discipline polypyridyl complexes were synthesised to study energy transfer processes.

A series of polymeric Co(II) and Cu(II) complexes using adipic acid as bridging ligand and 2,2'-bipyridyl as terminal ligand were synthesised and characterised crystallographically. Analysis of the structures show strong intra and inter molecular H-bonding interactions forming two-dimensional network structures.

Dinuclear Cu(II) complexes of diethylenetriamine, using dicarboxylato and substituted imidazolato ligands as spacer between the metal centres and also some schiff base complexes were synthesised as model systems. These complexes were characterised by optical methods, magnetic spectroscopic technique, and by single crystal X-ray diffraction. Structural, magnetism and reactivity studies of these complexes indicate that these are good models for superoxide dismutase (SOD).

Ru-clay as Catalyst gave cyclohexane and cyclohexene as reaction products in hydrogenation of benzene under specific reaction conditions. Alkylation of benzene with 1-dodecane catalysed by alumina pillared clay (APC) and silica-Alumina pillared clay (SIAPC) was investigated at the reflex temperature of benzene. SIAPC showed more conversion and selectivity toward linear alkyl benzene.

In Reactive Polymers discipline R&D work on the use of ion-exchange membranes as solid polymer electrolytes (SPE) has been initiated. A coating machine for continuous preparation of bi-polar membrane was designed, fabricated and installed. A few trials using non-woven cloth and woven cloth to prepare monopolar/bipolar membrane were taken.

In the Reverse Osmosis discipline efforts to develop Thin Film Composite (TFC) membrane based Reverse Osmosis Technology for desalination and waste water treatment was continued. Parameters for preparation Thin Film Composite membrane have been standardised to prepare 1m x 50 meter long membrane. Also 100 mm dia x 1.0 meter spiral element design was developed and tested successfully. A field plant of 40,000 liters/day capacity using indigenous TFC membrane/ elements is designed and installed at Madras Refineries Ltd., Chennai to study the membrane performance in field condition.

Reinforced polysulfone ultrafiltration/ microfiltration (UF/MF) membranes were prepared under different conditions. The surface of the UF/MF membranes modified with hydrophilic functional groups by in-situ formation of crosslinked polymeric structures.

The Biosalinity area comprises of two disciplines namely Phytosalinity and Marine Algae. In Phytosalinity work on improvement of desert economic plants was continued for the species Simarouba glauca, Jatropha curcus and Jojoba. Based on the R&D achievements on genetic improvement of Jojoba and location trials, UNDP has provided financial support to the tune of Rs.45 lakhs, to the Institute for large scale propagation of Jojoba along with Jatropha in the country. R&D work on conservation of germ-plasm of halophytes was also pursued. Screening of Salvadora, Simarouba and Jatropha spp. for bio-active principles was initiated.

In Marine algae discipline, culture and cultivation of edible seaweeds Porphyra and Monostroma was pursued. Selection and improvement of economic seaweeds Gelidiella acerosa, Gracilaria edulis, Sargassum wightii and Turbinaria conoides were undertaken. R&D work on cultivation of seaweed for bioactive substances covered the species Ulva fasciata, Monostroma species and Eucheuma.

Chemical investigation of bioactive compounds of marine algae was continued mainly as a component of the National Programme on "Drugs from Sea". Extracts of marine algae were sent to other participating laboratories to test various activities. Algal herbaria were sent to the Dept. Ocean Development (DOD) Central Repository at NIO, Goa.

As a part of the Coastal Ocean Monitoring And Prediction System (COMAPS) programme seawaters at Alang, Porbandar, Dwarka, Mithapur, Okha, Poshitra, Vadinar, Bedi and Kandla in the Saurashtra coast were monitored.

During the period of reporting the Extra Budgetary Resources generated showed a decline, mainly as a result of the grants received from various government agencies. However, the redeeming factor was the sizable increase in the Commercial Rupee earned from industry. On the whole the year was a fruitful year. The following chapters depict the progress in our endeavour and I hope this report will provide the reader with a perspective of the Institute's activities.

November 6,1998

S.D.Gomkale
(Acting Director)

DIRECTOR'S REPORT

1. अकार्बनिक रसायन क्षेत्र

1.1 नमक व समुद्री रसायन।

1.1.1 सबसोईल ब्राइन में से नमक का स्फटिकीकरण।

गुजरात के तीन विभिन्न स्थलों से प्राप्त किये गये सबसोईल ब्राइन के सौर-बाष्पन का अभ्यास किया गया। ब्राईन के प्रारंभिक घनत्व से 29-30° बामी तक की बाष्पन क्रिया का अभ्यास करके समुद्री बिटर्न के साथ तुलना की गई। प्रायोगिक ब्यौरे विभिन्न घनत्व पर स्फटिकों की गुणवत्ता में परिवर्तन, पूर्ण ब्राइन के आयोनिक मिश्रण तथा उचित क्रमबद्ध उत्कृष्ठ घनत्व द्वारा उच्च गुणवत्तावाला नमक प्राप्त करने की प्रक्रिया निर्धारित की गई।

1.1.2 कतार में सौर ऊर्जा द्वारा नमक उत्पादन की संभाव्यता।

कतार में सौर ऊर्जा द्वारा नमक उत्पादन की संभाव्यता के बारे में एक रिपोर्ट तैयार की गई। समुद्री जल से बाष्पन द्वारा नमक उत्पादन तथा बाद में नमक धुलाई तकनीक के प्रत्येक पहलू को इस रिपोर्ट में शामिल किया गया है। तकनीकी पहलू में प्रक्रिया यांत्रीकरण, पम्प, फील्टर, सोल्ट वर्कस के लिये आवश्यक वाहक जैसी साधान सामग्री उनकी विशेषताओं के साथ शामिल है। समुद्री जल की आवश्यकता, जमीन की आवश्यकता तथा अन्य सिविल अभियांत्रिकी ब्यौरे जैसे जमीन अनुकूलन, सौर तालाब, स्फटिकपात्र की रूपरेखा आदि के विस्तृत ब्यौरे निरूपित किये गये हैं। इस रिपोर्ट का उमता/उत्कृष्ट पहलू है, उत्पादित नमक की शुद्धता के लिए नमक धुलाई तकनीक का उपयोग परामर्श करार के अंतर्गत यह कार्य मेसर्स दलाल कन्सलटन्ट, मुंबई द्वारा किया गया।

1.1.3 ब्राईन से उच्च गुणवत्तावाले नमक की पुनः प्राप्ति।

जंबूसर (भरूच) से प्राप्त ब्राईन से उत्पादित नमक निम्न स्तर का तथा अनुपयुक्त था। इस समस्या के निराकरण के लिये संस्थान का संपर्क किया गया। संस्थान द्वारा उपयुक्त स्तर के नमक के उत्पादन के लिए योगात्मक प्रक्रिया का सुझाव दिया गया जो कैल्शियम सल्फेट के आयोनिक उत्पादन को बढ़ाता है और जो नमक की गुणवत्ता को मुख्य रूप से असरकर्ता है। नमक की गुणवत्ता सुधारने के लिए योगात्मकों (एडीटीव्हज़) का उपयोग अनुसंधान तथा विकास कार्यक्रम की अनूठी/उत्तम विशेषता है। यह कार्य मेसर्स पटेल सोल्ट वर्कस, जंबुसर, भरूच के परामर्श कार्य के अंतर्गत किया गया।

1.1.4 नमक धुलाई तथा परिष्करण की संभाव्य रिपोर्ट।

हिन्दुस्तान सोल्ट लिमिटेड, सांभार में नमक के 97-98 प्रतिशत से 99.5 प्रतिशत परिष्करण के लिये प्रतिवर्ष 60,000 टन नमक परिष्करण क्षमतावाली प्रस्तावित नमक धुलाई क्रिया की तकनीकी संभाव्यता तथा आर्थिक क्षमता का अभ्यास किया गया तथा रिपोर्ट तैयार की गई। इस रिपोर्ट में नमक परिष्करण के लिये प्रतिवर्ष 1 लाख टन की क्षमतावाली नमक धुलाई प्रक्रीया तकनीकी तथा आर्थिक संभाव्यता के बारे में जानकारी दी गई है। यह क्षमता प्रतिवर्ष2 लाख टन तक बढ़ाई जा सकती है। तदुपरांत रिपोर्ट में योजना की आर्थिक क्षमता का मूल्यांकन किया गया है। प्रस्तावित योजना के लिये उचित स्थल निर्धारित किया गया। यह कार्य परामर्श कार्य के अंतर्गत किया गया।

1.1.5 जलावरुद्ध (लोग्गड़) क्षेत्र के क्षारयुक्त पानी में से अकार्बनिक नमक की पुनः प्राप्ति।

इन्दिरा गांधी नहर परियोजना (आई. जी. एन. पी.) के प्रथम चरण में, निर्देशन के समय यह देखा गया कि कुछ क्षेत्रों में जमीन अत्यंत क्षारयुक्त होने से बीनुपजाउ/बंजर हो गई है। क्षेत्र उच्च भौमजलस्तरीय (हाई वोटर टेबल) होने की वजह से इस नमक को जलसिंचाई द्वारा हटाया नहीं जा सकता और इसीलिये ही नमक की पुनःप्राप्ति अनिवार्य है। क्षारयुक्त पानी से क्षेत्र निष्क्रियकृत हो गया है। वास्तव में यह बहुघटकीय नमक क्लोराइड, सल्फेट, नाइट्राईट, सोडियम, पौटाशियम,

मेग्नेशियम और कैल्शियमयुक्त हो गया है। नमकीन जल हल्के रूप में होने से किसी भी द्रवित नमक की पुनः प्राप्ति सीधे संभव नहीं है। अतः इस योजना की प्रक्रिया में द्राव्य नमक पर आधारित पारस्परिक घुलनशीलता द्वारा निर्धारित घनत्व अंतराल पर सौर बाष्पन तथा आंशिक स्फटिकीकरण शामिल है। नमक पद्धति के ब्यौरे से पता चलता है कि इन क्षारों में से किसी की भी सीधे शुद्ध रूप में पुनःप्राप्ति नहीं की जा सकती। ब्राईन के सांद्रीकरण के दौरान नमक मिश्रण अलग किया गया और नमक पद्धति के ब्यौरे के आधार पर प्रक्रिया करके शुद्ध अकार्बनिक नमक की पुनः प्राप्ति की गई। मेसर्स इंदिरा गांधी नहर परियोजना, बीकानेर द्वारा यह योजना प्रायोजित की गई।

1.2 सीलीकेट्स तथा उत्प्रेरण।

1.2.1 धातु संयोजनों का डिज़ाइन किये गये लिगेन्ड के साथ नई सामग्री के रूप में परिवर्तन।

संक्राति धातु संयोजनों का नये पदार्थों के रूप में विभिन्न परिवर्तन का विविध क्षेत्रों में उपयोग के कारण अकार्बनिक रसायनशास्त्र में इनका विशेष महत्व है। संक्रांति धातु संयोजनों को उनकी सूचक विशेषताओं के साथ डिज़ाइन करने के लिये किये गये प्रयत्नों के अंतर्गत ऐसे धातु संयोजनों को संश्लेषित करके उनके गुणधर्म, विभिन्न क्षेत्रों में उनके उपयोग, फलस्वरूप प्रत्येक क्षेत्र में प्राप्त सिद्धि आदि निम्नलिखित विभागों में संक्षिप्त रूप में प्रस्तुत किया गया है।

1.2.2 ऊर्जा परिवर्तन प्रक्रिया के अभ्यास में पोलीपीरीडील संयोजन।

रूथेनियम (III) (II) और फेरस (II) वाले लिगेन्ड के विषम द्वी तथा त्रिकेन्द्रीय धातुसंयोजनों, फेरोसीन के परीडील व्युत्पन्नों (डेरीवेटीव्ज़) पोलीकार्बोक्सिलिक एसिड और 2-2 -बायपीरीडीलका संश्लेषण किया गया। ये नये संयोजन रेडोक्स केन्द्रों के साथ विद्युत रसायन आंतःक्रिया में साधारण से निर्बल पाये गये। त्रिकेन्द्रीय संयोजन के रूथेनियम (III) ज्योतिर्मय ऊर्जा परिवर्तन मार्ग द्वारा संपूर्णत; तृप्त पाया गया। रूथेनियम (III) और आयरन (III) के सायनोब्रिज मिश्र संयोजकता वाले द्वि केन्द्रीय संयोजन संश्लेषित किये गये। इन संयोजनों ने आंतर संयोजकता विजभार परिवर्तन पट्टा (इन्टेन्स इन्टरवेलेन्स चार्ज ट्रान्सफर बेन्ड) तीव्र रूपसे दिखाया, और रूथेनियम (III) फेरस (II) श्रेणी ने धातुकेन्द्रों के बीच तटस्थ/दुरत्व आधारित आंतःप्रक्रिया दिखाई। मेटल मेटल चार्ज ट्रान्सफर (एम. एम. सी. टी.) पट्टे का थर्मोक्रामीज़म अभ्यास किया गया। विभिन्न लंबाई की श्रृंखला वाले एरोमेटिक संयोजन द्वारा पृथक किये गये बाईपीरीडल युनिटवाले लीगेन्ड का उपयोग करके रूथेनियम (II) और ऑस्मीयम (II) के सम, विषम द्विकेन्द्रीय संयोजन संश्लेषित किये गये और गुणधर्मों का परीक्षण किया गया। इन संयोजनों में से कई संयोजन धातुकेन्द्रों के बीच विद्युत रसायन आंतः क्रिया में निर्बल से साधारण पाये गये। ये सब संयोजन कक्ष के तापमान पर उत्सर्जन पट (एमीशन बेन्ड) प्रदर्शित करते हैं। एककेन्द्रीय रूथेनियम (III) पोलीपीरीडील संयोजन श्रृंखलाको संश्लेषित किया गया। विशिष्ट प्रतिक्रियात्मक शर्तों के अधीन/परिस्थितियों में लीगेन्ड का असाधारण जल-अपघटन (हाईड्रोलीसीस) पाया गया। जल-अपघटन की क्रियाविधि के प्रायोगिक ब्यौरे के आधार पर प्रक्रिया स्थापित की गई। एक स्फटीकीय क्ष किरण (सिंगल क्रिस्टल एक्स रे) के अभ्यास द्वारा इनमें से कुछ संयोजनों की आण्विक ज्यामितिय (मोलोकयुलर जीयोमेट्रीज) निर्धारित की गई/स्थापित की गई। इन संयोजनों में कार्बन डाइऑक्साइड से फोर्मिक एसिड विद्युत उत्प्रेरण कटौती (इलेक्ट्रोकेटालीटीकल रिडक्शन) की अभूतपूर्व क्षमता पाई गई। फोर्मीक एसिड की 70-80 प्रतिशत उत्पादन क्षमता पाई गई।

1.2.3 अधिशोषण के लिये संवर्ग बहुलक।

एडीपिक एसिड को ब्रीजींग लिगेन्ड रूप में और 2-2 बायपीरीडील अंतिम लिगेन्ड के रूप में लेकर कोबाल्ट (2) और कोपर (2) के बहुलक संयोजन की श्रेणी संश्लेषित की गई और स्फटिकीकरण द्वारा गुणधर्मों का परीक्षण किया गया। बंधारणीय पृथक्करण के द्वारा मज़बूत/सुदृढ़ अंतस्थ तथा बाह्य आण्विक हाइड्रोजन बंधन (एच-बोन्डिंग) परस्पर क्रिया से द्वि आयामीय नेटवर्क (जालीदार) संरचना पाई गई। झिगझेग बहुलक नेटवर्क संरचना के साथ इनमें से एक कोपर संयोजन ने मिट्टी समान

स्तरीय रचना बनाई तो दूसरे ने सरंध्र/छिद्रालु संरचना दिखाई। इन संयोजनों का उपयोग अधिशोषक तथा अलगीकरण अभ्यासीं में किया जायेगा।

1.2.4 जैवप्रतिरूपी (बायोमिमिक) आण्विक मोडल्स (नमूने)।

डाईकार्बोक्सिलेट और प्रतिस्थापित इमीडेजोलेटो लिगेन्डस को, दो धातुकेन्द्रों के बीच अंतरक के रूप में उपयोग करके डाइइथीलीन ट्रायमीन के द्विकेन्द्रीय कोपर (II) शीफ़ बेज़ संयोजनों को मोडल/प्रतिरूप के रूप में संश्लेषित किये गये। इन संयोजनों का प्रकाशीय पद्धति, चुंबकीय स्पेक्ट्रोस्कोपीक तकनीक और एक स्फटिक क्ष किरण विवर्तन (सिंगल क्रिस्टल एक्स रे डीफरेक्शन) द्वारा गुणधर्म परीक्षण किया गया। इन संयोजनों के संरचनात्मक, चुंबकीय और प्रतिक्रियात्मक (रिएक्टीविटी) अभ्यास द्वारा इनमें सुपरॉक्साइड डीस्म्युटीझ के लिये अच्छी प्रतिरूपता पाई गई। ज़िक (II) तथा कोपर (II) वाले प्रतिस्थापित (सबस्टीटयुटेड) मेटालोपोरफीरीन का संश्लेषण किया गया। विविध प्रायोगिक अवस्थाओं/परिस्थितियों में इन संयोजनों की रेडोक्स क्षमता तथा घनायन ऑक्सीकरण रेडिकल की विद्युत संरचना (इलेक्ट्रोनिक स्ट्रकचर) का भी अभ्यास किया गया।

1.2.5 थर्मोक्रोमीक पदार्थ।

डाइआल्काइल/टेट्राआल्काईल, इथलीन डाइएमीन और डाइहेजासाइक्लोहेप्टन के विविध ऋणायनों वाले लीगेन्ड के साथ कई निकल (II) तथा कोपर (II) संयोजनों का विश्लेषण किया गया तथा क्रिस्टलोग्राफीकली क्रिस्टल संरचनात्मक गुणधर्मों का परीक्षण किया गया। इनमें से कुछ संयोजनों ने प्रवाही नाइट्रोजन तापमान पर थर्मोक्रोमीक पारगम्यता (प्रतिलोमी रंग परिवर्तन) दर्शायी। कुछ नमूने का विविध तापमान पर सिंगल क्रिस्टल एक्सरे अभ्यास और संक्रांति के दौरान स्फटीक में आण्विक गतिविधियों की संरचनात्मक शक्ति (लॅटीस एनर्जी) का अभिकलन किया गया।

1.2.6 कार्बन कार्बन संतृप्त हाइड्रोकार्बन में स्थित बेन्ज़ीन तथा आल्कीन का जियोलाइट मोलेक्यूलर सीव्ज़ द्वारा अधिशोषण

फूडग्रेड हेक्ज़ेन में से बेन्ज़ीन का सक्रिय मोलेक्युलर सीव्ज़ द्वारा अधिशोषण प्रक्रिया का संशोधन किया गया जब 0.8 ग्राम बेन्ज़ीन/100 ग्राम फूडग्रेड हेक्ज़ेन को सक्रिय मोलेक्यूलर सीव्ज से भारित कोलम में से पारित किया गया तब अधिशोषण की चार प्रतिशत अधिशोषक क्षमता के सामने हेक्ज़ेन की 0.1 प्रतिशत समप्रमाण सांद्रता प्राप्त हुई। अधिशोषित बेन्ज़ीन को मोलेक्युलर सीव्ज़ में से उच्च तापमान पर अलग किया गया।

1.2.7 असंतृप्त कार्बनिक पदार्थ का हाइड्रोजेनेशन।

अच्छी उत्प्रेरणक्षमता पाने के लिए मिट्टी में कई धातु आक्साईड समाविष्ट करके उत्प्रेरक बनायेगये। विशिष्ट प्रतिक्रियात्मक परिस्थितियों में, रूथेनियम क्ले को उत्प्रेरक के रूप में लेकर बेन्ज़ीन के असंतृप्त हाइड्रोकार्बन की हाइड्रोजेनेशन प्रक्रिया की गई और फलस्वरूप साइक्लोहेक्ज़ेन और साइक्लोहेक्ज़ीन पाया गया।

ज़ियोलाइट छिद्रों में स्थापित किये गये रूथेनियम आयन की पिघले हुए सेलीन लिगेन्ड के साथ प्रक्रिया करके ज़ियोलाइट केवीटी में रूथेनियम सेलीन संयोजन बनाया गया। इन दोनों रूथेनियम विनिमय और रूथेनियम सेलीन ज़ियोलाइट का इन्फ्रास्पेक्ट्रा (आई. आर.) एकत्रित किया गया।

1.2.8 बेन्ज़ीन का आल्काईलेशन।

बेन्ज़ीन के उत्कलन बिंदु पर, एल्युमिनियम पीलर्ड क्ले और सिलिका एल्युमिना पीलर्ड क्ले से उत्प्रेरित डोडकेन के साथ आल्कांईलेशन किया गया। सिलिका एल्युमिना पीलर्ड क्ले ने रेखीय आल्काइल के लिये ज्यादा परिवर्तनशीलता और चयनशीलता दिखाई।

1.2.9 संश्लेषित अभिकर्मकों (रीएजन्टस) और क्ले द्वारा हाइड्रोक्सिलेशन।

विविध निकल/मेग्नेशियम और निकल एल्युमिनियम के अनुपात और सामान्य सूत्र (फार्म्युला) NiMgAl-$CO_3^-H^+$ वाले त्रिपरिमाणिय (टर्नरी) हाइड्रोटेलसाइट्स सहअवक्षपन (कोप्रेसीपिटेशन) पद्धति से संश्लेषित किये गये। इन प्रतिरूपों (मोडेल्स) का एक्स. आर. डी. और दूसरे सतही गुणधर्म परीक्षण पद्धति से परीक्षण किया गया। सल्फोनेटेड मेटलोएथेलोसाएनीन और पोरफिरिन को ऊपर बनाये गये हाइड्रोटेलसाइट्स के अंतःस्थ स्तर में स्थापित किया जायेगा और वायु अवस्था में हाइड्रोक्सिलेशन और अल्काइलेशन प्रक्रिया में उपयोग किया जायेगा।

1.2.10 प्रदूषण निवारण के लिये गुजरात नर्मदा वेली कोर्पोरेशन, के उच्छिष्ठ घन पदार्थो का उपयोगी पदार्थ में रूपांतरण।

गुजरात नर्मदा वेली कार्पोरेशन, भरूच के नाइट्रोफास्फेट के प्लान्ट में उर्वरक उत्पादन प्रक्रिया के दौरान कैल्शियम कार्बोनेट घन उच्छिष्ट पदार्थ के रूप में मिलता है जो अशुद्ध सघन और उसके कण का कद बड़ा होने की वज़ह से किसी भी औद्योगिक उपयोग का नहीं है। संस्थान ने इस घन उच्छिष्ट का उपयोगी पदार्थ में रूपांतरित करने की संभाव्यता के बारे में अभ्यास किया और रबर ग्रेड कैल्शियम कार्बोनेट और अवक्षेपित कैल्शियम कार्बोनेट जैसे उपयोगी पदार्थ में सफलतापूर्वक रूपांतरण किया। परंपरागत प्रक्रिया में रबर ग्रेड कैल्शियम कार्बोनेट और अवक्षेपित कैल्शियम कार्बोनेट लाइम स्टोन/चूने में से बनाया जाता है। अतः इस तरह से जी सी सी और पी सी सी की यह बनावट प्रक्रिया अजोड़ है। गुजरात नर्मदा वेली कार्पोरेशन ही एक ऐसी संस्था/कंपनी है जिसने घन कैल्शियम कार्बोनेट को उच्छिष्ट के रूप में प्राप्त करने वाली प्रक्रिया अपनायी है।

झिल्ली विज्ञान तथा प्रौद्योगिकी क्षेत्र

2.1 सक्रिय बहुलक।

2.1.1 घन बहुलक विद्युत अपघट्य (सॉलीड पोलीमर इलेक्ट्रोलाईटस)।

विद्युत रसायन ऑक्सिडेशन तथा न्यूनीकरण (रीडक्शन) के लिये आयन विनिमय झिल्लियों को घन बहुलक के रूप में उपयोग करने के प्रारंभिक कार्य शुरू किये गये। एक घन बहुलक विद्युत अपघट्य सेल की डिज़ाइन तैयार की गई और धातु आवरित (मेटल कोटेड) झिल्लियां विकसित की गईं। कुछ महत्वपूर्ण प्रतिक्रियाओं को पूर्ण करके प्राप्त नमूने का एन. एम. आर. द्वारा विश्लेषण किया जा रहा है और आशा है कि इस नये दृष्टिकोण/अभिगम से निर्मलक रसायनशास्त्र का नया मार्ग खुलेगा। (अर्थात कम प्रदूषण के साथ साथ विभाजन परिवर्जन (टालना)।

2.1.2 द्वि ध्रुवी झिल्लियां।

द्वि ध्रुवी झिल्लियां अविरत रूप से तैयार करने के उद्देश्य से एक कोटींग मशीन का डिज़ाइन एवं संरचना तैयार करके स्थापित किया गया। एकध्रुवी/द्विध्रुवी झिल्लियां तैयार करने के लिये बिना बुने हुए तथा बुने हुए कपड़ों का उपयोग करके परीक्षण किया गया। प्रयोगशाला के स्तर पर एक कोटींग मशीन तैयार किया गया तथा 10 मी × 14 से. मी. की सुदृढ़/प्रबलित (रेईनफोर्सड) घनायन विनिमय झिल्लियां बनाई गईं और उनकी प्रतिरोध क्षमता नापी गई। टेट्राब्युटाइल एमोनियम ब्रोमाइड में से टेट्राब्युटाइल एमोनियम हाइड्रोक्साईड तैयार करने के लिये प्रयोगशाला में प्रायोगिक कार्य किये गये।

2.2 नॉन आयोनिक बहुलक तथा झिल्लियां।

2.2.1 प्रतिवर्ती रसाकर्षण तकनीक पर आधारित संघटित पतली फिल्म झिल्लियां (टी. एफ. सी.)।

1 मी × 50 मी. लम्बी झिल्ली तैयार करने के लिए संघटित पतली फिल्म तकनीक का मानकीकरण किया गया। 100 मि.मी. व्यास × 1.0 मीटर का सर्पिल (स्पाइरन) साधन विकसित किया गया तथा सफल परीक्षण किया गया। इस सर्पिल साधन में 9.0 वर्ग मी. झिल्ली स्थापित की गई है जो सामान्य परिस्थितियों में प्रतिदिन प्रतिसाधन 4000 लीटर उत्पादन करती हैं।

स्वदेशी संघटित पतली फिल्म झिल्लियों वाला तथा प्रतिदिन 50,000 लीटर की क्षमता वाला संयंत्र विकसित किया गया तथा क्षेत्र की परिस्थितियों में उसकी कार्यक्षमता का परीक्षण करने के लिये मद्रास रिफाइनरीज़ लिमिटेड चैन्नई में स्थापित किया गया हैं।

विकसित संघटित पतली फिल्म झिल्लियां नमकीन जल में 95 प्रतिशत क्षार दूर करने में सक्षम हैं और पहले तैयार की गई सेल्युलोज़ एसीटेट झिल्लियों की तुलना में इन झिल्लियों की उत्पादन क्षमता दुगुनी है। तदुपरांत सेल्युलोज़ झिल्लियां 2 साल तक कार्य कर सकती हैं जबकि ये झिल्लियां विशेष रूप से टिकाऊ हैं और 3-5 साल तक कार्य करने में सक्षम हैं।

2.2.2. परानियंदन (अल्ट्रा फिल्ट्रेशन)/सूक्ष्म नियदन।

विभिन्न परिस्थितियों के अंतर्गत सुदृढ़ (रेइनफोसर्ड) पोलीसल्फोन परानिस्यंदन/सूक्ष्म निस्यंदन झिल्लियां तैयार की गई।

बहुलकी संरचना की स्वस्थानीय तिर्यक बंधन संधि (क्रोसलीकड पोलीमरीक स्ट्रक्चर्स) रचना द्वारा हाइड्रोफीलीक फंक्शनल ग्रुप के साथ इन झिल्लियों की सतह को परिवर्तित/उपचरित किया गया। इन झिल्लियों का आण्विक भार विलगक मूल्य (मोलेक्युलर वेईट कट-आफ) नापा गया। झिल्लियों का आण्विक विलगक मूल्य इस प्रकार रहा, 1,20,000, 65,000, 40,000 और10,000 डी. ए.। उच्च आण्विक भार विलगक झिल्लियों ने 3.5 कि.ग्रा./सेमी^{2} के परिचालक दाब पर 17,00-25,00 एल. एम. डी पानी के प्रवाह के साथ वाय गलोब्युलीन ब्रोबीन सिरम आल्व्युमीन का 95 प्रतिशत अवरोध दर्शाया/अस्वीकृति दर्शाई। 2000 पी. पी. एम. वाले जलीय द्रावण के परीक्षण के लिये, 5-7 किग्रा./सेमी^{2} के परिचालक दाब पर तथा1000-1500 एल एम डी पानी के प्रवाह के साथ, सतह परिवर्तित झिल्लियों ने सोडियम क्लोराइड के लिए 60-85 प्रतिशत और सोडियम सल्फेट के लिए 85-95 प्रतिशत वियोजन दिखाया। (सतह परिवर्तित झिल्लियां 60-85 प्रतिशत सोडियम क्लोराइड तथा 85-95 सोडियम सल्फेट दूर करने में सक्षम पाई गई) ये झिल्लियां निम्न आण्विक भार वाले कार्बोनिक तथा अकार्बन विलयनों के पृथक्करण, विभाजन अथवा बृहत् आण्विय सांद्रता (कोन्सन्ट्रेशन ऑफ मेक्रो मोलेक्युलस) के लिए उपयोगी हैं।

जैवलवणता क्षेत्र

3.1 पादप/वनस्पति लवणता।

3.1.1 मरुस्थल के आर्थिक दृष्टि से उपयोगी पौधों में सुधार/संशोधन।

कच्छ (गुजरात) में उगने वाले सीमरोबा ग्लौकाकी उपज तथा पुष्पन क्रिया का मूल्यांकन/परीक्षण किया गया और देखा गया कि ये पौधे उभयलिंगी हैं तथा उगाने के बाद चौथे साल में प्रतिपौधा 10-20 किग्रा. उत्पादन देते हैं। इसमें कारनेल तैलीय तत्व 62.17 से66.98 प्रतिशत पाया गया।

जेट्रोफा तथा सीमरोबा के बीज अंकुरण तथा संवर्धनगृह तकनीक का मानकीकरण किया गया और जेट्रोफा कर्कस के बीजांकुर खेडूतो में वितरित करने के लिये तैयार किये गये (ये28एकड़ बंजर भूमि पर लगाये गये है)

जर्मनी से प्राप्त किये गये जेट्रोफा के विष रहित बीज़ भावनगर (गुजरात) तथा बेरहामपुर (उड़ीसा) में वृद्धि मूल्यांकन के लिये उगाये गये।

कच्छ (गुजरात) में उगाये गये जोजोबा के उत्पादन का मूल्यांकन किया गया। 455 मादा पौधों से कुल 59.49 किग्रा. बीज उत्पादन पाया गया। चयन किये गये 17 मादा पौधों से 500ग्राम/प्रतिपौधा अतिरिक्त उपज प्राप्त हुई और 3 पौधों से प्रति पौधा 1 कि. से भी ज्यादा प्राप्त हुई।

जोजोबा के 1500 बीजांकुर से और 2500 शाखा काट के पौधे उगाये गये तथा ए. जे. ओ. आर. पी. (राजस्थान) के सहयोग से निम्नस्तरीय जमीन पर फलोद्यान बनाने के उद्देश्य से दृढ़ीकरण (हार्डनींग) के लिये रखे गये।

3.1.2 हेलोफाईट्स के जनन द्रव्यों का संरक्षण।

स्युयेदा न्युडीफलोरा की सूक्ष्म प्रजनन तकनीक की अधिकृत प्रक्रिया विकसित की गई और कोष स्तर पर नमक सहयता(सोलर टलरन्स) जानने के लिये सेल्स कल्चर उगाया गया।

स्युयेदा न्युडीफलोरा की बायोमास उत्पादन वृद्धि तथा नाइट्रोजन चयापचय (मेटाबोलीझम) कामूल्यांकन करने के लिये इसे अमोनियाम क्लोराईड के NH_4Cl 100 तथा 200 मिलीमोल सांद्रतावाले जल से सींचा गया और देखा गया कि उपरोक्त सभी मानक में MNH_4Cl के100 मिलीमोल सांद्रता वाले जल की सिंचाई से वृद्धि हुई।

3.1.3 जैव सक्रियता (बायोएक्टिव) कार्यशक्ति/क्षमता के लिये सेल्वेडोरा, सीमरोबा और जेट्रोफा की छंटाई।

सेल्वेडोरा पर्सीका, सीमरोबा, ग्लौका, एटरीप्लेक्स न्युमलेरिया पौधों के अलग अलग भाग के मीथेनाल अर्क तैयार किये गये और जैव सक्रियता परीक्षण के लिये सी. डी. आर. आई. लखनऊ, आइ. आइ. सी. बी., कलकत्ता सी. बी. टी., नई दिल्ली, आर. आर. एल. जम्मू तथा सीमैप, लखनऊ भेजे गये।

3.2 समुद्री शैवाल।

3.2.1 आर्थिक दृष्टि से उपयोगी समुद्री शैवाल का चयन एवम् सुधार/वृद्धि।

जेलीडीयेला एसरोजा, ग्रेसिलेरीया इडयुल्स सरगासम वायटी और टरबिनारीया शैवाल की नस्ल के चयन तथा कुदरती आबादी के लिये मन्डपम क्षेत्र के आसपास के स्थलों से शैवाल एकत्रित करके अभ्यास किया गया। उनकी बायोमास उत्पादन क्षमता (ग्राम ताजा भार/0.25 वर्गमीटर) वृद्धि तथा सघनता (सेमी) आदि प्राचालों के बारे में अनुसंधान कार्य किया गया।

3.2.2 खाद्य समुद्री शैवाल की खेती और संवर्धन।

खाद्य समुद्री शैवाल के अनुसंधान कार्य अंतर्गत प्राकृतिक पोरफेयरा शैवाल एकत्रित की गई और समुद्री जल में उगाकर संवर्धन किया गया। कार्पोबीजाणुओं की झड़ने की क्रिया का निरीक्षण किया गया। अनुवर्ती अंकुरण क्रिया देखने के लिये प्रत्येक उपज के बीजाणु संरोपण के छोटे से भाग को फिर से उगाया गया। 24 घंटे के बाद सभी बीजाणु नलिकाकार तंतु के रूप में अंकुरित हुए जो बाद में शंखाकार कोशिकावाले बीजाणु उद्‌मिदीय (स्पोरोफाइटीक) के रूप में विकसित हुए।

इसमें समाहित कार्बोहाइड्रेट्स तथा प्रोटीन की मात्रा का अनुमान लगाया गया। प्रत्येक सूखे हुए शैवाल में प्रोटीन की मात्रा में 17.2 से 29.0 प्रतिशत तक की विभिन्नता पाई गई और कार्बोहाइड्रेटस की मात्रा में भी 31.0 से 34.7 प्रतिशत तक की विभिन्नता पाई गई।

3.2.3 समुद्री शैवाल के जैव सक्रियता संयोजनों का रासायनिक संशोधन।

हरित, काली और लाल शैवाल जैव सक्रियता/नये कार्बनिक अणुओं को पहचानने के तथा अलग करने के लिये शैवाल के मेथेनोल और जलीय अर्क का रासायनिक संशोधन करने के उद्देश्य से सौराष्ट्र तथा तामिलनाडु समुद्रीतट से हरित, काली और लाल शैवाल एकत्रित की गई। "समुद्र से औषधि" राष्ट्रीय कार्यक्रम के भागस्वरूप समुद्री शैवाल के अर्क को विभिन्न सक्रियता के परीक्षण के लिये इस कार्यक्रम में भाग लेने वाली प्रयोगशालाओं में भेजा गया।

INORGANIC CHEMICALS

1.1. SALT & MARINE CHEMICALS

1.1.1 Fractional crystallisation of salt from sub-soil brine

Solar evaporation studies of sub-soil brines from three different locations of Gujarat were undertaken. Evaporation of brines from their initial densities to 29-30° Be- density was studied and the data compared with those of sea brine. From the experimental data, the change in quality of salt crystallized at various density levels with changing ionic composition of an ideal brine and proper density ranges for the recovery of high quality salt are identified.

The experimental data evolved can be utilized for recovery of high quality salt from sub-soil brines in situ. It will provide guideline to the salt manufacturers to identify the correct density levels at which good quality salt can be harvested from sub-soil brines.

1.1.2. Feasibility of solar salt production in Qatar

The feasibility report for producing high quality salt by solar evaporation of sea water followed by salt washing in Qatar was prepared. The report covers all the aspects of producing salt by solar evaporation of sea water followed by salt washing. The technical aspects include mechanisation of the process listing the equipments such as pumps, filters, conveyors required for the salt works with their specification. The information regarding the sea water requirement, land requirement and other civil engineering data like soil conditioning, lay out of salt ponds, crystallizers, etc. have been dealt with in detail. The mechanical salt washery for the purification of salt produced is a unique aspect of this report.

1.1.3. Recovery of good quality salt from sub-soil brine

Salt produced from subsoil brine available at Jambusar (Bharuch) is reported to be of inferior and inconsistent quality. The problem was referred to the Institute and a method for the production of consistent quality salt was suggested by the external additives which enhance the ionic product of calcium sulphate, which is the main impurity affecting the quality of salt. With the improved method the party can produce good and consistent quality of salt. The use of additives for improving the quality and yield of salt is a unique feature of the R&D programme. M/s C.M.Patel Salt Works at Jambusar, Bharuch referred the problem, which was taken up as a consultancy assignment.

1.1.4. A feasibility report on salt refinery and washery

The report provides information regarding the techno-economic feasibility of salt refining using salt washery with a capacity of 1 lakh tpa. The capacity is expandable upto 2 lakh tpa. The report covers the assessment of the economic viability of the project. A suitable location for the proposed project has been identified. With the proposed salt washery it will be possible to upgrade the salt from 97-98 per cent to 99.5 per cent purity which is the industrial demand. The client will be able to market its refined salt for human consumption as well as industrial grade salt for caustic soda plants in northern and eastern regions of the country, more competitively than any other salt manufacturers. The project was undertaken for M/s. Hindustan Salts Limited, Sambar.

1.1.5. Recovery of inorganic salts from saline water from water logged areas

It is observed that a large quantity of salt has surfaced in some parts in the command area of stage-1 of Indira Gandhi Nahar Pariyojana (IGNP) and which have made the land unfit for cultivation. These salts cannot be drained out by application of irrigation water due to the high water table in the area and hence it has become necessary to recover these salts. The saline water logged around the area, in fact, constitute multi-component salt system comprising chlorides, sulphates and nitrates of sodium, potassium, magnesium and calcium. The direct recovery of any of the dissolved salts is not possible as the saline water is in a dilute form. Hence the projected process involves the concentration of the brines by solar evaporation and fractional crystallisation of dissolved salts based on their mutual solubility at definite density intervals. The solubility data of the salt systems indicate that none of these salts can be recovered directly in their pure form. The salt

mixtures separated during the course of concentration of brines are further processed for the recovery of inorganic salts in their pure form employing the phase data of the relevant salt systems. M/s. IGNP (Indira Gandhi Nahar Pariyojana), Bikaner sponsored the project.

1.2. SILICATES & CATALYSIS

1.2.1 Polypyridyl complexes to study energy transfer processes

Hetero bi- and tri-nuclear metal complexes of Ru(III)/(II) and Fe(II) incorporating the ligands, pyridyl derivatives of ferrocene, polycarboxylic acids (edta) and 2,2'-bipyridyl were synthesised. All these new complexes show a moderate to weak electrochemical interaction between the redox centres. Luminescence of Ru(II) centre in the trinuclear complexes is completely quenched presumably through energy transfer pathway. Cyano bridged mixed valence dinuclear complexes of Ru(III) and Ru/Fe(II) were synthesized. These complexes exhibit an intense intervalance charge transfer band and Ru(III)-Fe(II) systems show a distance dependent interaction between the metal centres. Thermochromism of the metal-metal charge transfer (MMCT) band has been studied. A series of homo and hetero-dinuclear complexes of Ru(II) and Os(II) using binucleating spacers having bipyridyl units separated by aromatic moieties of different lengths with complete conjugation were synthesised and characterised. Most of these complexes show weak to moderate electrochemical interaction between the metal centres. All these complexes exhibit emission bands at room temperature. A series of mononuclear Ru(III)-polypyridyl complexes have been synthesised. Under a particular reaction condition an unusual hydrolysis of the ligand was observed. On the basis of experimental data mechanism of the hydrolytic process was established. Molecular geometry of some of these complexes were established by single crystal X-ray studies. These complexes show excellent catalytic property towards electrocatalytic reduction of carbon dioxide to formic acid, 70-80 percent current efficiency for the production of formic acid was observed.

1.2.2. Coordination polymer for adsorption

A series of polymeric Co(II) and Cu(II) complexes using adipic acid as bridging ligand and 2,2'-bipyridyl as terminal ligand were synthesised and characterised crystallographically. Analysis of the structures show strong intra and inter molecular H-bonding interactions forming two-dimensional network structures. One of the Cu(II) complex showed layered clay like structure whereas the other one exhibited porous structure with zigzag polymer network. These complexes will be used for adsorption and separation studies.

1.2.3. Biomimitic molecular models

Dinuclear Cu(II) complexes of diethylenetriamine, using dicarboxylato and substituted imidazolato ligands as spacer between the metal centres and also some schiff base complexes were synthesised as model systems. These complexes were characterised by optical methods, magnetic spectroscopic technique, and by single crystal X-ray diffraction. Structural, magnetism and reactivity studies of these complexes indicate that these are good models for superoxide dismutase (SOD). Substituted metalloporphyrin containing Zn(II) and Cu(II) were also synthesised. Redox properties of these new complexes at different experimental conditions and also the electronic structures of the oxidised cationic radicals have been studied.

1.2.4. Thermochromic materials

A number of Ni(II) and Cu(II) complexes with the ligands dialkyl-/tetraalkyl-ethylenediamine and diazacycloheptane with various anions have been synthesised and characterised crystallographically. Some of these complexes exhibit thermochromic transitions (reversible colour change) at liquid nitrogen temperature. The variable temperature single crystal X-ray studies of some samples and the lattice energy computations for the molecular motions involved in the crystal during transition were carried out (in collaboration with IICT, Hyderabad).

1.2.5. Benzene and alkene present in C_5-C_7 saturated hydrocarbons: Adsorption process using zeolite molecular sieves

Adsorption of benzene from Food Grade Hexane (FGH) on activated molecular sieve has been investigated. When the FGH containing 0.8 gm of benzene/100 gm of FGH was passed through a column packed with activated molecular sieve, at 4 percent adsorption capacity of adsorbent, 0.1 percent equilibrium concentration of hexane was obtained. The benzene adsorbed on the molecular sieve can be desorbed by FGH at high temperature.

1.2.6. Hydrogenation of unsaturated organic substrates

Many metal oxide catalysts incorporated on clay have been prepared which showed catalytic activity for the hydrogenation of unsaturated hydrocarbons. Ru-clay as catalyst gave cyclohexane and cyclohexene as reaction products in hydrogenation of benzene under specific reaction conditions.

Ru ion encapsulated in zeolite is reacted with molten salen ligand to prepare Ru-salen complex in zeolite cavities. IR spectra of the Ru-exchange and Ru-salen zeolite samples were collected.

1.2.7. Alkylation of benzene

Alkylation of benzene with 1-dodecane catalysed by alumina pillared clay (APC) and silica-Alumina pillared clay (SIAPC) was investigated at the reflex temperature of benzene. SIPAC showed more conversion and selectivity toward linear alkyl benzene.

1.2.8. Hydroxylation using clays and synthetic reagents

Ternary hydrotalcites of general formula NiMgAl-CO_3-H^+ with different Ni/Mg and Ni/Al ratio were synthesized by coprecipitation technique. The samples are characterized by XRD, IR and other surface characterization methods. The sulphonated metallophthalocyanine and porphyrins are being incorporated into the interlayer of the hydrotalcite and will be used for the vapour phase hydroxylation and alkylation reactions.

1.2.9. Converting solid waste of GNFC to value added material (calcium carbonate) for pollution abatement

In the manufacturing process of fertilizers in Nitrophosphate plant of Gujarat Narmada Valley Fertilizer Corporation, (GNFC), Bharuch, calcium carbonate is coming out as solid waste. Being impure, dense and large in particle size, this material is not suitable for any industrial applications. CSMCRI, Bhavnagar carried out feasibility studies and successfully converted this solid waste to value added materials such as rubber grade ground calcium carbonate (GCC) and PVC grade precipitated calcium carbonate (PCC).

Based on the technical report submitted after completing the feasibility studies, the GNFC has decided to assign a full-fledged project to CSMCRI, for which a project proposal is being submitted. The manufacturing process for GCC and PCC by this route will be unique as the conventional raw material used is limestone. GNFC is the only company that adopts a route which yields solid waste (calcium carbonate). If GNFC adopts the process technology to convert their waste to value added material, they will have cost benefit. As most of the manufacturers of GCC and PCC are located in the Northern India, GNFC will have the market potentiality in the western region. This will also solve the pollution problem of GNFC.

MEMBRANE SCIENCE & TECHNOLOGY

2.1 REACTIVE POLYMERS

2.1.1. Solid polymer electrolyte

Preliminary work on the use of ion-exchange membranes as solid polymer electrolytes (SPE) has been initiated in order to carry out electrochemical oxidation and reduction. A SPE cell has been designed and metal quoted membranes are being developed. Some reactions of importance have been carried out and samples are being analysed by NMR. It is hoped that this new approach will open up avenues for cleaner chemistry (less polluting as well as avoiding separation steps).

2.1.2 Bipolar Membranes

A coating machine for continuous preparation of bi-polar membrane was designed, fabricated and installed. A few trials using non-woven cloth and woven cloth to prepare monopolar/bipolar membrane were taken. A lab. scale coating machine was arranged and some 10m x 14 cm reinforced cation-exchange membranes were prepared and their resistance measured. A few trial experiments were carried in a laboratory stack to prepare tetrabutyl ammonium hydroxide from tetrabutyl ammonium bromide.

2.2 NON-IONIC POLYMERS & MEMBRANES

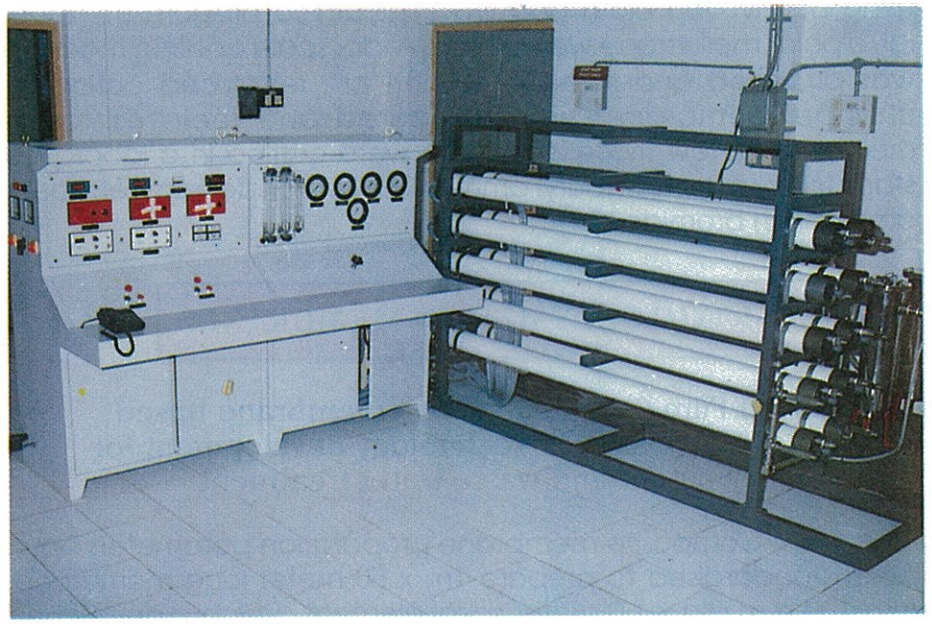
2.2.1 Thin Film Composite (TFC) membrane based Reverse Osmosis Technology development for desalination and waste water treatment

Thin Film Composite membrane preparation parameters have been standardised to prepare 1m x 50 meter long membrane. Also 100 mm dia x 1.0 meter spiral element design is developed and tested successfully. This spiral element accommodates 9.0 sq. meter membrane area and produces about 4000 liters per day per element at normal operating condition. This indigenously developed spiral element are presently under test in field conditions. The TFC membrane can reject 95 percent of total salt in water. Also it has double the output compared to earlier developed Cellulose Acetate Membrane. Moreover, it has about 3-5 years life compared to earlier membrane which had 2 years working life.

A field plant of 40,000 liters/day capacity using indigenous TFC membrane/ elements is designed and installed at Madras Refineries Ltd., Chennai to study the membrane performance in field condition.

2.2.2 Ultrafiltration/ Microfiltration

Reinforced polysulfone ultrafiltration/ microfiltration (UF/MF) membranes were prepared under different conditions using a motor driven continuous casting machine. The surfaces of the UF/MF membranes were modified with hydrophillic functional groups by in-situ formation of crosslinked polymeric structures. The molecular weight cut-off (MWCO) values of the membranes were measured with a dead end cell ultrafiltration apparatus using aqueous solutions of dextran of different molecular weights as probe solutes. The MWCO values of the membranes are as follows: 120000, 65000, 40000 and 10000 Da. The high MWCO membranes exhibited above 95 percent rejection of γ-globuline, bovine serum albumin with water fluxes of 1700-2500 lmd at the operating pressure of 3.5 kg/cm^2. The surface modified membranes have shown separations of above 60-85 percent for NaCl and 85-95 percent of Na_2SO_4 with water fluxes of 1000-1500 lmd when tested for 2000 ppm aqueous feed solutions at 5-7 kg/cm^2. The membranes are useful for the separation, fractionation and/or concentration of macromolecules, low molecular weight organic compounds and inorganic solutes



Reverse Osmosis Pilot Plant for setting up at MRL, Chennai (Cap. 40000 lit./day)

DOD Research Vessel "SAGAR PASCHIMI" wherein Reverse Osmosis Prorotype installed for treatment of sea water

3.1 PHYTOSALINITY

3.1.1 Improvement of desert economic plants'

Simarouba glauca growing in Kutch (Gujarat) was assessed for yield and flowering behaviour. It was observed that plants were showing sexual dimorphism and the seed yield ranged from 10-20 kg/plant for 4th year of plantation. The oil content of kernel ranged from 62.17 to 66.98 percent.

Seed germination and nursery techniques were standardised for Jatropha and Simarouba and 15000 seedlings of *Jatropha curcus* were raised for distribution to farmers/tribal farmers (approx. 28 acres of wasteland has been covered).

Seeds of non-toxic variety of Jatropha obtained from known source are raised at both Bhavnagar (Gujarat) and Berhampur (Orissa) to assess the performance.

Performance of Jojoba growing in Kutch (Gujarat) was assessed for yield. A total yield of 59.49 kg seed was obtained from 455 female plants. 17 selected female plants gave more than 500 g yield per plant and 3 plants gave more than one kg per plant.

Based on the R&D achievements on genetic improvement of Jojoba and location trials, UNDP has provided financial support to the tune of Rs.45 lakhs, to the Institute for large scale propagation of Jojoba along with Jatropha in the country.

15000 seedlings of Jojoba and 2500 stem cuttings were raised and put for hardening in collaboration with Association of Jojoba Research Projects (AJORP), Rajasthan, for taking up seed orchard on degraded lands.

3.1.2 Conservation of germ-plasm of halophytes

A protocol was developed for micro propagation of *Suaeda nudiflora* and *Callus cultures* were raised to understand the salt tolerance mechanism at cell level.

Jojoba nursery at Jalgaon - March 1998 (Under UNDP/TMOP Programme)

Jojoba plantation at Rameswaram

Suaeda nudiflora irrigated with 100 and 200 mM of NH_4Cl was assessed for growth biomass production and nitrogen metabolism and found that all the above said parameters are increased with 100 mM NH_4Cl treatment.

3.1.3 Screening of Salvadora, Simarouba and Jatropha spp. for bio-active principles

Methanol extracts of *Salvadora persica, Simarouba glauca, Atriplex nummularia* (different plant parts) were prepared (65) and sent to CDRI, Lucknow; IICB, Calcutta; CBT, New Delhi; RRL, Jammu and CIMAP, Lucknow for bio-evaluation.

3.2 MARINE ALGAE

3.2.1 Culture and Cultivation of edible seaweeds

Study of biology, cultivation and nutritional aspects of *Porphyra* and *Monostroma* as edible seaweeds are pursued.

Species of *Porphyra* collected from natural habitats, after proper treatment were cultured in enriched seawater medium. Mass shedding of carpospores were observed. A small volume of spore inoculum from each culture was further cultured to follow up subsequent spore germination stages. All the spores, after 24 hours gave rise to a tubular filament which later developed into sporophytic filaments free living conchocellis. Further work to obtain leafy blade-like genotyphytic thallus from conchocelis thallus is being carried out.

The protein and carbohydrate content were estimated. Protein content varies from species to species and ranged from 17.2 to 29.0 percent on dry weight basis. The highest (29 percent) was recorded in *P. suborticulata*. Carbohydrate content also varied from species to species and generally ranged between 31.0 and 34.7 percent on dry wt. basis. However, in case of *P. kanyakumariensis* and *P. suborticulata* it was found to be 17 and 23 percent, respectively.

Major minerals like Na, K and Ca and trace elements like Cd, Fe, Zn, Ni and Cu were also estimated. Ca content varied from 6.25 to 9.00 percent, K from 4.00 to 7.25 percent and Na from 0.75 to 2.00 percent on dry wt. basis. Ni and Cu were present in very trace levels. The Fe content with a few exception varied from 61.75 to 91.00 mg/100 g. dry wt, Zn from 3.75 to 24.25 mg/100 g. dry wt. and Cd from 0.5 to 3.0 mg/100 g. dry wt.

3.2.2 Selection and improvement of economic seaweeds

For selection of strains, natural population occurring at different localities around Mandapam region have been studied, the parameters investigated being biomass (g.fr.wt. 0.25 m^{-2}), length (cm) and bushiness (cm).

Gelidiella acerosa: The biomass values varied with season and location, and exhibited cyclic pattern with low biomass in June and showing an upward trend thereafter for the remaining period after a drastic increase in July. Among the sampling stations studied, Ervadi possessed relatively superior population. The maximum biomass of 160.0 $\pm$ 25.16 was recorded for Ervadi in August and lowest of 22.33 $\pm$ 5.71 for Rameshwaram in June.

Gracilaria edulis: Seasonal variation in biomass was observed in *Gracilaria edulis.* There was a gradual decline from April to June and thereafter upward trend was observed till November. Of the two sites studied (i.e. Rameshwaram and Gulf of Mannar), Gulf of Mannar contained *G. edulis* abundantly. The minimum biomass of 348.33 $\pm$ 30.18 with percentage cover of 40.33 $\pm$ 14.31 and length 13.96 $\pm$ 2.46 and bushiness of 467.73 $\pm$ 397.84 was registered for Gulf of Mannar in August, 1997.

Sargassum wightii: Seasonal trends in growth characteristics was observed in *Sargassum* also. Unlike Mandapam population the plants at Pudumadam showed gradual increase in their growth and biomass from April to September. However, at both the places drastic increase in all the parameters were observed from July to August and thereafter the variation remained in a narrow range. The maximum biomass of 2941.66 $\pm$ 268.35 with 100 percent cover and length 31.60 $\pm$ 6.35 of plants were registered in population at Pudumadam coast in September.

Turbinaria conoides: *Turbinaria* also showed a growth period from April to September. The Ervadi population exhibited peak growth in September with biomass 3041.66 $\pm$ 181.23 with 100 percent cover, 29.03 $\pm$ 4.19 length and 110.63 $\pm$ 33.48 bushiness.

3.2.3 Cultivation of seaweed for bioactive substances

Field cultivation of *Ulva fasciata* using floating culture net system was done at Diu during November, 1997 to March, 1998. The growth and yield of cultivated material of *Ulva fasciata* was more or less the same as compared to the field cultivation system in the intertidal region on the coast of Diu (av. wt. 600 g fresh/ m^2). Samples of cultivated *Ulva fasciata* and those collected from natural habitat were provided for preparation of extracts for testing bioactivity.

Isolation and fusion of *Monostroma* species collected from the coast of Goa was achieved. Fused protoplast generated cell within 48 hours and the differentiation of the morphogenesis was observed after 4 days.

Data was collected on the growth of red algae *Eucheuma* in culture, outdoor and controlled conditions in Bhavnagar. In the outdoor conditions the growth varied from 24 percent to 4 percent over initials during the period October to December. During the same period, under laboratory conditions the growth varied from 44 percent to 16 percent (at 20 $\pm$ 2°C, 12-12 h L:D photoperiod). *Eucheuma* plants were also grown under field conditions in the sea at Diu and good growth was achieved.

Experiments on tissue culture of *Eucheuma* under aseptic *in vitro* condition was carried out. Callus formation was achieved. New proliferations were also generated from cut end of the axis.

3.2.4 Chemical investigation of bioactive compounds of marine algae

Green, brown and red marine algal species were collected from Saurashtra and Tamil Nadu coasts for carrying out chemical investigation of methanol and aqueous extracts to isolate and identify bioactive/new organic molecules. As a part of the National Programme on "Drugs from Sea" extracts of marine algae were sent to other participating laboratories to test various activities. The details are as follows:

CDRI: 36 green, 7 red and 13 brown algal extracts were sent for evaluation of bio-activity and seasonal and ecological variation studies in bio-activity. Additional amount of four samples were also sent for confirmation of anti-implantation activity. Three fractions were sent for antibacterial activity test.

MUI: 33 green, 6 red and 13 brown algal extracts were sent for antibacterial, antifungal and antiviral activity tests. Three fractions were also sent for anti-HIV(RT) activity testing.

IICT: 10 green, 5 red and 6 brown algal extracts were sent for pesticidal activity testing. Three fractions were also sent for larvicidal activity test.

Sixty-two algal herbaria were sent to the Dept. Ocean Development (DOD) Central Repository at NIO, Goa.

A brown algal species belonging to genus *Sargassum* was studied for its polysaccharide content. The $CaCl_2$ and acid extracts were chromatographed on DEAE Cellulose Columns repeatedly. The first yielded four fractions and the second three fractions. For all the fractions sugar, sulphate, uronic acid and fucose contents were estimated. Sulphate and fucose contents increased with increasing concentration of NaCl in the eluting solution whereas uronic acid content decreased.

A green algal species belonging to the order *Siphonales* was investigated for its sulphated polysaccharide (SPS) content. The cold and hot water extracts were chemically analysed for their sugar, protein, sulphate and uronic acid content. Cold water extracts contain high sugar and sulphate and lower uronic acid and protein.

3.2.5 Coastal Ocean Monitoring

The seawaters at Alang, Porbandar, Dwarka, Mithapur, Okha, Poshitra, Vadinar, Bedi and Kandla in the Saurashtra coast were monitored during 1997-98. The results of these monitoring programme revealed beyond doubt that the costal waters of this region of Gujarat are more or less clean, unpolluted and exhibit a healthy marine environment. The dissolved oxygen, BOD and pH varied in a normal range at most of the transects and stations. However, some localised stress conditions were observed at some of the transect. Alang exhibited higher values of total dissolved solids, iron, zinc, nickel, copper, lead, cobalt and mercury in sea water and manganese in sediment. However, least/low values of salinity, chlorophyll-*a*, phaeophytin, phytoplankton count and its genetic diversity, were also observed at this transect. Alang also recorded lowest/low values of fresh and dry weight of zooplanktons.

Porbandar also showed localised stress conditions due to discharge of effluent, which resulted in highest/higher values of nitrate, nitrite, ammonia, total nitrogen, phosphate, total phosphorus, chlorophyll-*a*, phaeophytin, copper, lead, cadmium, cobalt, in seawater and copper in sediments. This transect also exhibited highest/high count of phytoplankton and its generic diversity, fresh weight, dry weight and volume of zooplankton. The *Amphiprora* and *Lyngbya* among phytoplanktons and Mysids among zooplanktons were recorded only from this transect.

Kandla recorded highest/ higher concentration of total suspended solids, salinity, manganese, nickel and mercury in sea water and mercury in sediment. It also showed lowest/lower values of chlorophyll-*a*, phaeophytin and phytoplankton count. The salinity was also high at Vadinar and Bedi.

Dwarka showed highest values of lead in sediment and low DO in seawater. Mithapur recorded higher values of pH, of seawater, cobalt and copper in sediment. The highest/higher values of iron and zinc in sediment were recorded at Poshitra. *Synedra* was recorded only from this transect. The highest/higher values of Petroleum hydrocarbons in seawater, cobalt and cadmium in sediment were recorded from Vadinar transect. *Echinoderm larve* was recorded only from this transect. The Bedi transect recorded, highest/higher values of phosphate in seawater and nickel and cadmium in sediment.

Thirty-four genera of phytoplanktons and twenty-two groups of zooplanktons were observed from the different stations of nine transects. Quite a number of genera/groups had widespread distribution at these stations. The group diversity of zooplanktons was high at Okha, Vadinar and Bedi also.

Most of the pathogenic bacteria had patchy distribution. They were in non-detectable range at quite a number of stations but they had high count at many other stations. The highest/ higher count of TVC, TC, ECLO, SHLO, SLO, VPLO, VLO and SFLO in seawater were recorded at Alang. Bedi recorded the highest count of TVC, SHLO, SLO and VCLO.

Okha recorded higher count of TC and PKLO whereas Poshitra recorded highest/higher count of VCLO and VPLO in seawater. The highest/higher count of PKLO, SLO and PALO in seawater were observed at Dwarka, Mithapur and Kandla respectively. Similar higher count of different groups of bacteria were also recorded from marine sediment.

Chapter 4

TECHNOLOGY TRANSFER & INFRASTRUCTURE SERVICES

4.1 PATENTS

1. Complete specification sent to IPMD. "Process for the manufacture of Zeolite-A useful as a detergent binder", R.S. Somani, P.M. Oza, M.R. Gandhi and V.M. Sheth. (NF 26/97, Pat. Appl. No. 1865/DEL/97 Dt. 4/7/97)
2. Filed - The Tractor operated salt farm Ridger (Harvester) Complete specification., H.N. Patel and Sudhir Bhat. (N.F. 303/97, Pat. Appl. No. 1678/DEL/98 Dt. 16/6/98)

4.2 PROCESSES RELEASED

1. "Free-flow salt" process released to M/s Malhotra Salt & Chemicals Pvt. Ltd., Ahmedabad.

4.3 GRANT-IN-AID/SPONSORED/CONSULTANCY/ COLLABORATIVE PROJECTS

4.3.1 Grant-in-aid Projects:

Sr.No	Project Title	Source of funding	Amount Rs.
1.	Manpower Development Programme.	Dept. of Ocean Development, New Delhi	95,840
2.	Development of seawater RO Desalination plant	Dept. of Ocean Development, New Delhi	4,25,000
3.	Development of Nitrate selective resins for removing nitrate in potable water.	Ministry of Environment & Forests, New Delhi	91,560
4.	Magneto-structural investigation in	Dept. of Science & Technology,	4,00,000

	transition metal spin cross over complexes and reactivity correlations.	New Delhi	
5.	Preparation of base paper on control of trackishness in drinking water and holding of expert group meeting to evolve issue based status papers for the National Workshop.	CSIR, New Delhi	2,50,000
6.	Studies on activation and reduction of N-N Bonds by transition metal complexes at bare and modified electrodes in aqueous solution.	Dept. of Science & Technology, New Delhi	75,000
7.	Synthesis, electrochemistry photo-chemical properties of Ruthenium (II) and Osmium (II) multinuclear metal complexes.	Dept. of Science & Technology, New Delhi	1,00,000
8.	Synthesis, characterization and physico-chemical studies of new redox active mono and binuclear complexes with donor acceptor properties.	Dept. of Science & Technology, New Delhi	6,00,000
9.	Studies on biodiversity of economic seaweeds and their improvement for cultivation.	Dept. of Biotechnology, New Delhi.	2,17,000
10.	Studies on thermochromic phase transitions in crystals using variable temperature single crystal X-ray methods	Dept. of Science & Technology, New Delhi	90,000

11.	Asymmetric epoxidation of prochiral alkenes in homogeneous/heterogeneous system by chiral schiff base complexes with first row transition metals.	Dept. of Science & Technology New Delhi	1,40,000
12.	Coastal ocean monitoring and prediction system (COMAPS) Programme	Dept. of Ocean Development, New Delhi	8,04,000
13.	Incorporation of anionic macrocyclic transition metal complexes into the intergallery of layered double hydroxides and their catalytic properties towards selective oxidation reactions.	Dept. of Science & Technology, New Delhi	3,00,000
14.	Studies on transition metal analyzed reactions of Diazoketones.	Dept. of Science & Technology, New Delhi	3,50,000
15.	Development of electrolytic dissolution process to recover acid and alkali from industrial effluent salt solution.	Dept. of Environment & Forest, New Delhi.	96,140
16.	Model biovillage project at Gorsad (Porbandar)	Dept. of Biotechnology, New Delhi	21,58,000
17.	Development of micro and ultra-filtration technique using membrane filters for refining of vegetable oils.	CSIR, New Delhi for Technology Mission on Oils & Pulses (TMOP)	10,00,000
18.	Culture and cultivation of seaweeds for foods	Dept of Biotechnology, New Delhi	1,85,000
		Total	73,77,540

4.3.2 Sponsored Projects:

Sr.No	Project Title	Source of funding	Amount Rs.
1.	Cultivation of *Gracilaria edulis* at Mandapam	M/s SNAP Natural & Alginate Products Ltd., Ranipeth	50,000
2.	Development of process for preparation of Zeolite-A (Detergent Grade) from aluminium waste.	M/s Viral Alkalies ltd., Mumbai.	3,00,000
3.	Assessing the possibilities of recovery of chemicals from saline lands of IGNP, Bikaner.	Project Director, IGNP, Bikaner	75,000
		Total	6,50,000

4.3.3 Collaborative Projects:

Sr.No	Project Title	Source of funding	Amount Rs.
1.	Indian Reference Material	National Physical Laboratory, New Delhi	50,000
2.	To generate a knowledge-base for preparation of free flow iodized salt of required specification.	M/s Hindustan Lever Ltd., Mumbai	2,75,000
		Total	3,25,000

4.3.4 Consultancy Projects:

Sr. No	Project Title	Source of funding	Amount Rs.
1.	Preparation of Environmental Impact Assessment Report for a New Ship building project at Chanch Bunder.	M/s Alcock Ashdown (Guj.) Ltd., Bhavnagar.	1,00,000
3.	Technical feasibility and economic viability of salt refinery.	M/s. Hindustan Salts Ltd., Jaipur.	2,50,000
4.	Preparation of pre-feasibility report on production salt by solar evaporation of sea water followed by salt washing in Qatar.	M/s Dalal Consultants & Engrs. Ltd., Mumbai.	6,00,000
5.	Environmental impact assessment studies.	M/s Birla VXL Ltd., Porbandar.	6,20,000
6.	Assessment of utility of salt deposits in Greater Rann of Kutch	Industries Commissioner, Govt. of Gujarat.	3,00,000
		Total	18,70,000

4.4 TECHNICAL ASSISTANCE & MISCELLANEOUS RECEIPT

Technical assistance		Rs. 2,32,020
Analysis & Testing Charges		Rs. 1,42,785
Technology Transfer		Rs. 8,000
Royalty / Premia		Rs. 8,48,752
	Total	Rs.12,31,557

4.5 TRAINING

1. Sophisticated Analytical Instrumentation Laboratory of CSMCRI has imparted training to Shri A.B. Bhatti, Lecturer, Dept. of Physics and Chemistry , Sir Bhavsinhji Polytechnic Institute on Role of Analytical Instruments in Industry from 29-9-1997 to 24-10-1997.
2. Scientists from Salt, Marine & Inorganic Chemicals Discipline of the Institute visited Salt works in Kharaghoda, Dhrangadhra and Kuda in Saurashtra, Kutch, etc. and gave training to salt manufacturers (Agarias) for improving quality and yield of salt. Total number of participants was around 1000. The programme was arranged at the instance of Gujarat Rural Development Agency, Gandhinagar.

3. Two M.Sc. students from the Department of Botany, Pune University undergone training in different aspects of Marie Algae such as Biology, Culture, Cultivation and Utilisation of Seaweeds from 22-4-1997 to 16-6-1997.

4. Training and demonstration of agrotechnology for Jojoba and Jatropha cultivation were imparted to farmers and State Dept. officials under the UNDP **Project on 'Utilization of Wasteland with the Traditional Oil Seed Plant Species"** as follows:

   a) Fifty farmers were trained in a Farmers Meet arranged at Bhavnagar on 27-02-1998 for cultivation of Jojoba and Jatropha.

   b) Fifty farmers from Sikar Dist. (Rajasthan) were trained for two days (14th and 15th March, 1998) and provided with know-know to cultivate Jojoba.

   c) Training and demonstration of agrotechnology of Jojoba cultivation was provided to 50 officials of State Govt. (DRDA) including Watershed Development Team (WDT) members on 21-08-1997.

   d) State level workshop-cum-training programme on Jojoba cultivation was arranged at Jaipur on 19-20th June, 1997. About 40 farmers and officials from State Agriculture Dept. attended the programme.

   e) Farmers and officials from Soil Conservation Dept., Orissa Govt. numbering about 70 were participated in a Farmers meet for training organised on 25-11-1997 at Berhampur (Orissa)

4.6 AWARDS

Dr.R.S.Somani along with Dr.P.M.Oza, V.M.Sheth (voluntarily retired) and Shri M.R. Gandhi have been awarded the prestigeous "Technology Award" by National Research Development Corporation (NRDC), New Delhi on the eve of Independence Day, the 15th August, 1997 for developing technology for manufacturing Detergent grade Zeolite-A, a worldwide accepted substitute for sodium tripolyphosphate, presently used in detergent formulations as builder material. The award carries Rs.1,00,000 in cash.

The award winning process technology is unique, cost-effective and eco-friendly which involved reaction of sodium aluminate liquor from Alumina Refinery with sodium silicate solution under optimized conditions to form gel which is subsequently subjected to crystallisation, resulting in formation of detergent grade Zeolite-A at par with international standards. The technology has been released to M/s. National Aluminium Company Ltd., (NALCO), Bhubaneswar, through NRDC, New Delhi at a highest ever premium of Rs.13.5 million. NALCO has engaged Engineers India Ltd., New Delhi for installing a commercial plant of the capacity 10,000 tonnes/day at Damanjodi, Dist. Koraput, Orissa, which will give a rare distinction to NALCO of becoming the world's only Detergent grade Zeolite-A plant of its kind.

4.7 SEMINAR/CONFERENCES/SYMPOSIA/ WORKSHOPS

4.7.1 Workshop on Cultivation of Jatropha Curcus:

One day Seminar-cum-Wrokshop on Cultivation of *Jatropha Curcus* under UNDP Project was organized on 25th November, 1997 at Berhampur Field Station of the Institute. The first ever meet was very successful as more than 60 farmers participated. The Collector, Ganjam District also attended the meet. Dr. E.R.R. Iyengar, Emeritus Scientist, was present during the deliberations in the seminar.

4.7.2 Workshop on Consumer Satisfaction Evaluation

The Director General, CSIR has initiated an exercise to evolve a system for measurement of Customer Satisfaction and has appointed Dr. S.Banerjee, former Director of NML and R&D Centre for Iron & Steel (RDCIS). Dr. Banerjee took two meetings in which Lab. Representatives from seven labs. in the Chemical Sciences Group participated. For a test sample, seventeen industrially sponsored projects which were completed/due for completion by March, 1997 were selected and the sponsors were requested to provide their evaluation of the respective projects. They were also invited to attend the second meeting and express their views. Most of them accepted the methodology and opined that the exercise would benefit both the lab. and the sponsor as the basic objective is to enhance consumer satisfaction.

After considering all the aspects that emerged in these meetings a Final Draft was prepared and it was decided that the industrially sponsored projects due to be completed during 1997-98 may be evaluated using the methodology proposed. To facilitate generating a clear understanding of the system a Workshop was organised at the Institute on 20th February, 1998. Prior to the meeting, the Consultant wrote to each of the participants and sought their views on various aspects of the proposed methodology. He also requested the Principal Investigators of industrially sponsored projects to evaluate their projects. In the meeting various aspects of the methodology were clarified. The basic philosophy behind embarking on such an exercise was also put forward. The summary of the responses from the participants and also of the self evaluation of the projects by PIs was presented in the meeting. In the ensuing discussions on the proposed methodology, the participants expressed their views and apprehensions clearly. On the whole the idea was overwhelmingly recognised and the methodology was accepted as adaptable.

4.8 Participation in training programmes

Name & Desig	Topic	Place	Duration
Scientists, Engineers, Techni-cians, staff from Admiministration and Accounts (45 participants).	Computer training organised by the Institute with the expertise from Bhavnagar University.	CSMCRI, Bhavnagar	July - Oct. 1997
Scientists & Engine-ers (19 participants)	-do-	-do-	Dec. 97 to March, 98.
Stenographers (12 participants)	-do-	-do-	28 hours. spread over three months from 22nd Jan. 98
Dr. S.H.Zaidi, Sci.C	Remote Sensing - an over- view for Decision Makers	Indian Instt. of Remote Sensing, Dehradun	8-11 July, '97
Dr.M.P.Reddy, Sci.'C'	PCR Walking on Genomic DNA, sponsored by DBT.	Organised by TERI, Delhi.	27th Aug. to 12th Sept., 97
Sh. H.S. Vasudev, JTA	Computer training	Bhavnagar Univ., Bhavnagar	
Sh. Balraj Singh, Section Officer	Preparation of basic Rosters	Instt. of Socio-Economic Research & Action, N.Delhi	26-28 Nov. 97
Sh.Asish Badheka, LDC (Hindi)	Computer training	CSIR New Delhi	12-17 Jan. '98
Dr.(Mrs.) Aruna R. Prakash, JTA	Biotechnological application on plant tissue and cell culture for the production of phytochemicals and plant improvement.	CFTRI, Mysore	2-22 Feb., 98
Staff from Berhampur Field Station	Computer training	Digital Electronics & Computer, Berhampur.	One month

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4.8.1 Participation in Seminars/Symposia/Workshop:

Name & Desig.	Events	Date
Dr.R.V. Jasra, Dr. H.C. Bajaj, Dr.N.N. Rao, Dr.S.Kannan and Dr.R.S. Somani, Scientists	13th National Symp. on Catalysis, Indian Institute of Petroleum, Dehradun	2-4 Apr. 1997
Dr.(Mrs.) Parmita Ray, Scientist	Symp. on Membrane based separation processes Sci.&Technology, Jadhavpur Univ., Calcutta.	19-21 Feb., 98
Sh. S.N.Sah, Scientist	Hindi Conference, Bangalore.	28-29 Aug., 97
Dr.P.M.Gaur, Scientist & Dr.(Ms) S.V.Joshi, Scientist	USAID sponsored Workshop on Cost Effective Environmental Management for Dyestuff Industries, Opportunities for India - US, organised by IIE and ATIRA, Ahmedabad.	9th June, 1997

TECHNOLOGY TRANSFER & INFRASTRUCTURE SERVICES

Sh. J.B. Pandya Scientist, & Dr.J. Chikara, Scientist	Two-day State level Workshop-cum-Training on Jojoba Cultivation arranged by Govt. of Rajasthan & Assocn. of Rajasthan Jojoba Plantation & Research Project, Jaipur.	19-20 June, '97
Dr.Amjad Hussain, Scientist and Sh. P. Iyer, Proj Assistant.	National Workshop on Catalysis, RRL Trivandrum.	11-13 Dec. 1997
Dr.P.S.Anand, Scientist	Seminar on Challenges in Separation Process as applied in Petrolium Ind., IIP, Dehradun.	7-8 Aug , 1997
Dr.S.D. Gomkale, Actg. Director	CSIR R&D Management Programme on Leadership & Change, Management & Finance for R&D Personnel at Institute of Microbial Technology, Chandigarh	30th Aug., 6th Sept., 1997
Sh.J.R. Chunawala, Scientist	Seminar on Energy Conservation organized by IIChE at Veraval	30th August., 1997
Dr.S.D.Gomkale, Acting Director and Dr.R.V.Jasra, Scientist	Seminar on Chemical Engineering in Gujarat - Golden Jubilee Year 1947-1997 organized by Baroda Regional Centre of IIChE, Baroda.	27-28 Sept., 1997
Shri P.Krishnan, AO and Shri C. Badarinath, CoA	Executive Development Program-me, CCMB, Hyderabad organised by CSIR.	15-19 Sept. 1997
Dr.S.D. Gomkale, Actg. Director	Third Management Programme for Directors and Senior Scentists at CCMB and IICT, Hyderabad.	16-20 Oct., 1997

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Dr.K. Rama Rao, Scientist	67th Annual Session of Academy of Sciences, RRL, Bhubaneshwar.	24-28 Oct., 1997
Sh. P.S. Reddy, SRF	National Seminar on Advances in Polymer Science, Chennai.	21st July, 1997
Sh.V.G.S. Kumar, Project Assistant	National Symposium on Oceanography and Coastal Zone Management, Visakhapatnam.	23-24 April, 1997
Dr.M.P. Reddy, Scientist	Conference on Frontiers in Bio-technology, RRL, Trivandrum.	26-29 Nov., 1997
Dr.S.D. Gomkale, Acting Director.	CSIR Management Development Programme on Management of Technology Innovation, NIO Goa.	17-18 Nov, 1997.
Shri D. Sherwood, Scientist	Seminar on STN at NCL, Pune	18-19 Aug., 1997
Shri R.J. Sang-havi, JTA	Workshop on Modern Analytical Techniques, Instrumentation methods and Trouble shooting held at PERD Centre, Ahmedabad	29-31 Aug, 1997.
Dr.R.S.Shukla, Sci-entist	Workshop on Characterization of Advanced Materials & Environmental Issues, NPL, New Delhi.	21-22 Aug., 1997
Shri E. Suresh, STA	XVIII National Seminar on Crystallography, Mahatma Gandhi University, Kottayam.	24-26th Sept., 1997
Dr.P.M.Gaur, Scientist	Workshop on Water Pollution Assessment and Management, Indo-German Nachkontakt Association, Hyderabad.	9-10 Oct., 1997

TECHNOLOGY TRANSFER & INFRASTRUCTURE SERVICES

Sh.B.D.Shethia, Technical Officer.	International Workshop on Medicinal Plants, their Bioactivity, Screening & Evaluation, at CDRI, Lucknow.	2-5 Dec., 1997
Dr.AVR Reddy, Scientist	IUPAC International Symposium on Advances in Polymer Science and Technology at CLRI Chennai.	5-9 Jan., 1998
Sh.Kripal Singh, Scientist	National Conference on Recent Trends in Membrane Science & Technology, CGCRI, Calcutta.	20-22 Nov., '97
Dr.. N.V. Desai & Dr. D.B. Shukla, Scientists.	Workshop on Intellectual Property Rights & Management (IPR & M), organized by IPM Divn. of CSIR at NIO Goa.	10-11 Nov., '97
Dr.A.K.Siddhanta, Scientist	Seventeenth National Symp. on Organic Chemistry on Natural Products and Drug development, University of Calcutta, Calcutta.	23-25 Sept., 97
Dr.A.S.Mehta, Scientist	Seminar on Chem. Engineering, IIT, N.Delhi.	14-18 Dec., 1997
Dr.H.M. Mody, Scientist	National Workshop on X-ray Analysis(XRAN-98), Jawaharlal Nehru Aluminium Research Development & Design Centre, Nagpur.	19-21 Jan., 1998
Dr.D.Srinivas, Scientist and Sh.P.C.Dave, Project Asstt.	National Symposium on Magnetic Resonance and Liquid Crystal, IISc, Bangalore.	4-7 Feb., 1998

Sh. Kripal Singh, Scientist	International Seminar on World Scenario in Oil, Oleochemicals & Surfactant Industries Oil Technologists Association of India, Lucknow.	12-14 Feb., 98
Sh.C.Badarinath, Controller of Administration.	Programme on Domestic Industry Proceedings & Impact, Excel Industries Ltd., Bhavnagar.	26th Dec., 1997
Dr. Parimal Paul, Scientist and Dr.Mohan M Bhadbhade, Scientist	Symposium on Modern Trend in Inorganic Chemistry at IIT, Kanpur.	4-6 Dec., 1997
Dr.Mohan M Bhadbhade, Scientist	School on Molecular Modeling of Materials at Supercomputer Education & Research Centre, organized by Jawaharlal Nehru Centre for Advanced Scientific Research and Solid State Chemistry Unit, at IISc. Bangalore	12-16 Jan., '98
Sh.D.Sherwood, and Dr.S.Muthusamy, Scientists	Workshop on STN CAS Technical Days to carry out literature/patent search on various available scientific and technical (STN) data bases by using internet facility at NCL Pune conducted by Chemical Abstracts Service, Ohio, USA	4-6 Feb., 1998
Dr.S.K.Adhikary, Scientist	International Conf. on Disperse System, Jadavpur University, Calcutta.	19-21 Feb. 1998
Dr. K. Rama Rao,& Dr.K.Eswaran, Scientists	Workshop on Cultivation of Seaweeds in the Gulf of Mannar; organised by M.S. Swaminathan Res. Foundation, Chennai	11-12 Feb., 1998

Sh. A.K. Bilakhia, Project Assistant.	Seminar on Metallorganics, IIT Madras.	21-23 Feb., 1998
Sh.Vinod Kumar Shahi, Pool Officer	National Symp. on "Recent Trends in membrane transport" Univ.,Varanasi.	19-20 March, 98

4.9 FOUNDATION DAYS

4.9.1 CSMCRI Foundation Day Celebration:

Forty-fourth Foundation Day of CSMCRI was celebrated on 10th April, 1997. Dr. S.D. Gomkale, Acting Director presided over the function. Shri R.N. Vohra, Senior Scientist welcomed the audience.

Prof. G.D. Yadav, Prof. of Inorganic Chemical Technology, Chemical Engg. Divn., University Dept. of Chemical Technology, Mumbai, delivered the Foundation Day Lecture. In his lecture entitled **"Excitement Engineering : Rocks, Coals and Catalysis",** he elaborated the ideas centered around pores and their connections to macroscopic occurrence. Everything around us is full of pores - some interconnected, conducting, accessible whereas some totally isolated. Citing a Sanskrit verse : ***Chhidreshu anartha bahuli bhavanti*** (pores lead to many disasters and calamities), Prof. Yadav said that understanding pores and studies related to their physical properties like porosity, pore structure, surface and interfaces contained by them will lead to modification of above cited Sanskrit verse to ***Chidreshu vasati saukhyam (prosperity lies in pores).*** This he elucidated giving the results of his work on recovery of oil, improving utility of coal and greener and efficient catalytic reactions leading to much needed products. Prof. Yadav described how, based on their studies, recovery of oil can be enhanced from oil wells. According to him, even an additional one per cent recovery from a given reservoir is thousands of barrels of oil. While discussing the usefulness of studies on physical properties of pores in the catalysts and ion-exchange resins used in chemical industry he showed the results his group obtained at UDCT which lead to more efficient recovery, less byproducts generation and thereby less pollution, longer life of catalysts and resins, etc. Single pot synthesis of methyl-tert-butyl ether (MTBE) which is one of the fastest growing chemicals worldwide is one of the well studied applications, he said.

Dr. S.D. Gomkale in his presidential address highlighted the achievements of CSMCRI and its activities which are linked with science at one end and the society at the other end. The Foundation Day Lecture delivered by Prof. Yadav will help CSMCRI in

Dr.S.D. Gomkale, Acting Director delivering his Presidential address.

Prof. G.D. Yadav, Prof. of Inorg. Chemical Technology, Univ. Dept. of Chemical Technology, Mumbai receiving a memento

going nearer to industry for results oriented interaction, Dr. Gomkale said.

Shri C. Badarinath, Controller of Administration proposed vote of thanks.

4.9.2 CSIR Foundation Day Celebration

CSIR Foundation Day was celebrated on 26th Sept., 1997. Dr. S.D.Gomkale, Acting Director presided over the function.

Shri D.N. mathur, Railway Divisional Manager, Bhavnagar Division delivering the CSIR Foundation Day lecture

Shri R.N. Vohra, Senior Scientist while welcoming the audience traced the genesis of CSIR and gave brief insight on the **CSIR Vision 2001** authored by Dr. R.A. Mashelkar, Director General of CSIR.

The Foundation Day Lecture was delivered by Shri D.N. Mathur, Divisional Railway Manager, Bhavnagar Division, Western Railway. Shri Mathur said that, if the country has to compete and survive in the process of globalization, it cannot do so without adequately paying attention to R&D which is simply indispensable. The Indian Railways could achieve the magnificent feat of worldwide recognition solely due to the concerted and dedicated R&D efforts of its Research Design & Standard organization

(RDSO), Shri Mathur added. Stressing further on the need of R&D he said that we should not expect immediate results from R&D as it demands reasonable gestation period. Today services of Indian Railways are requisitioned by other countries which speaks eloquently on the competence of Indian Railways which has stood the test of time, said Shri Mathur. He praised the efforts of CSIR for creating sound R&D infrastructure in scientific and industrial research with noteworthy achievements.

As a part of CSIR Foundation Day celebration, Shri Mathur felicitated and presented *Mementos* and *Prashastipatras* to the Scientists who completed 25 years and 33 years of service in CSIR. Hari Om Prerit SS Bhatnagar award was also presented at the hands of Shri Mathur on this occasion to Dr. P.K. Tiwari of BARC for his research work on Development of Thermal Desalination

Dr. S.D. Gomkale, Acting Director, in his presidential address gave a statistical information of financial input on R&D of various developed countries and said our country spends only a meager amount on R&D. He emphasized that the industry should share a major burden and contribute more funds for R&D. Dr. Gomkale also drew attention to the low output of international patents. He emphasized R&D organizations to take up assignments in the light of challenges of 21st Century and recommended to do away with the unproductive and obsolete research.

The Institute was kept open for public on 25th Sept., 1997 and R&D achievements and activities were explained with exhibits and working plants to the visitors.

4.10 INVITED LECTURES

Name & Address	Topic	Date
Prof. Eberhard Staude, University of Essen, Germany.	Electrokinetic characterization of porous membranes.	25-11-1997
	Chemically modified polymers for synthetic membranes	26-11-1997
	Electrokinetic characterization of porous membranes.	1-12-1997
	Characterization of ED membranes and their applications.	

Dr. Bharat Parekh, Scientist, Centre for Disease Control, Atlanta, Georgia, USA.	New Developments in AIDS Research.	11-12-1997
Prof. K. Kishore, Indian Institute of Science, Bangalore.	Glass transition behavior in long chain molecules.	30-12-1997
Dr.S.Banerjee, Consultant to CSIR and Industry.	Organisation and Management of Innovation.	20-2-1998

4.11 LIBRARY SERVICES

The CSMCRI Library is considered to be a premier one in this region having a rich collection of books, periodicals, reference materials, etc. in the areas of R&D being carried out in the Institute. Not only it caters to the information need of R&D staff of the Institute but also extends the facilities to the research scholars, university staff, representatives of the industries, Government officials and others. A brief account of library collection, facilities, services are given below:

Total collection during 1997-98:

No.	Name of Document	Position as on 1/4/97	Addition during 1997-98	Total as on 31/3/98
1.	Books	11072	43	11115
2.	Back Volumes	20040	1644	21684
3.	Translation	420	--	420
4.	Photocopy	1840	34	1874
5.	Patents	300	--	300
6.	Standards	743	1	744
7.	Microcards	67	--	67
8.	Microfilm	1326	--	1326
9.	Maps/Charts	263	--	263
10.	Reprints	2680	1	2681
11.	Annual Reports & Pamphlets	7859	97	7956
	Total	46610	1820	48430

Journals subscribed:

1.	Foreign Journals	: 118
2.	Indian Journals	: 115
3.	Journals received in Gratis/exchange	: 40

Information Services:

For easy and quick access to current and latest information by the R&D staff, library renders various information services to its readers. Through this services, scientific and technical staff are kept well informed with the current trends in the field of their interest. The services rendered are as follows:

Monthly addition list.
Monthly News Brief service.
Monthly Newspaper clippings services.
Inter-library loan service.
Reader queries.
Reprints and photocopy mailing.
Supplying bibliographies on selected areas using current contents.

Literature Search Facilities to outsiders:

This library is having specialised up-to-date collection of international abstracting services viz. Chemical Abstract, Biological Abstracts, Current Content, Indian Science Abstracts, Back Volumes of Journals in Chemistry, Chemical Technology, Biological Sciences, etc. The outsiders are also granted permission to consult the documents in the library. This fulfills the aim of maximum utilization of library documents.

During the period under report library has granted permission to outsiders as follows:

Long term permission	:	41
Short term permission	:	68
Outsiders consulted the Lib.	:	376

Computerisation:

The Library is having a computer network based on Novel **Netware** and computerisation of various library services and in-house functions are under progress. For easy and quick access to information, library has started to subscribe to Electronic Media of Current Content from 1996.

4.12 PUBLICATIONS BROUGHT OUT

CSMCRI News Letter (Bilingual, Monthly) 12 issues.

Biennial Report 1994-1996

4.13 FOREIGN SCIENTISTS' VISIT TO CSMCRI

1. Researcher ABE Sakurako, Visual Folklore Inc., Japan, 201 Terrace Ogure, 1-10 Naito-cho, Shinjuku-ku, Tokyo, Japan -160, visited the Institute on 10th October, 1997 and had discussion with our scientists on conditions of salt making in Indian village and the process of salt making in India.
2. Prof. Horst Kisch, Institute of Inorganic Chemistry, University of Erlangen-Neumber, Egerlandstr, 1-D-91058, Erlangen, Germany visited the Institute from 14th 18th Oct., 1997 under CSIR-DAAD Bilateral Exchange Programme.
3. Dr. Vladiir M. Sedivy, Director, Salt Technologies, KREBS & Co.Ltd., Zurich, Switzerland visited the Institute on 16th October, 1997 for discussion with our Scientists for the purpose of business.
4. Prof. D. Eberhard Staude, Institute for Technische Chemie, Universitat GH Essen, Essen, Germany visited our Institute from 22nd Nov. to 4th Dec., 1997 under CSIR-DAAD Exchange of Scientists Programme.

4.14 FOREIGN DEPUTATION/VISIT BY CSMCRI SCIENTISTS

1. Dr. P.S. Anand, Scientist E.I was deputed to U.K. for attending training programme on "Laboratory Safety Management" at the Industry Centre, University of Sunderland, Sunderland, U.K under CSIR Safety Programme for a period of 29 days from 4th May, 1997 to 1st June, 1997.
2. Dr. R.S. Somani, Scientist B was deputed to Japan for participation in the International Symposium on Zeolite and Microporous Crystals (SMPC'97) held at Tokyo, Japan during 24-27 August, 1997.
3. Shri K.M. Majeethia, Scientist 'F' was deputed to Qatar from 24th to 30th August to participate in the discussion and see the actual field conditions in connection with the Qatar Solar Project which is under consultancy agreement between Dalal Consultants & Engineers Ltd., Mumbai and CSMCRI, Bhavnagar. Shri Majeethia again visited Qatar during 28th Nov. to 7th Dec., 1997 for participation the Second Phase of discussion.
4. Dr.H.C. Bajaj, Scientist E.I was deputed to Germany for a period of three months from 1st October to 31st December 1997 under DAAD Re-invitation Programme to carry out studies on the redox chemistry of Ru(III) and Ru(II) complexes on Polyaminocarboxylic acid and their uses as oxotransfer catalysis.
5. Shri R.J. Tayade, JTA was deputed to Switzerland from 9th to 13th February 1998 for equipment training for operation and maintenance of Bruker DPX 200 FT - NMR Spectrometer at Spectrospin, Switzerland under the purchase agreement of the equipment.
6. Shri P.S. Subramanian, Sci. B was deputed to Switzerland visited Switzerland from 16th to 26th February, 1998 for equipment training for operation and maintenance of Bruker DP X 200 FT-NMR Spectrometer at Spectorspin, Switzerland under the purchase agreement of the equipment
7. Dr. S.Kannan, Sci. C was deputed to the Netherlands for a period of one week from 2nd to 6th March, 1998 for equipment training on Philips X'pert MPD System at Philips Analytical X-ray, B.V. Almelo, Netherland under the purchase agreement of the equipment.
8. Dr. H.M. Mody, Sci. B was deputed to the Netherlands for a period of one week from 2nd to 6th March, 1998 for equipment training on Philips X'pert MPD System at Philips Analytical X-ray, B.V. Almelo, Netherland under the purchase agreement of the equipment.

Chapter 4

TECHNOLOGY TRANSFER & INFRASTRUCTURE SERVICES

PAPERS PUBLISHED DURING APRIL, 1997 TO MARCH 1998

Inorganic Chemicals

1. Mixed valence properties of a new dinuclear complex ((Edith) Ru(III) NC Ru(II) $(CN)_5)^{4-}$ and kinetic studies of the aqua substitution reaction in Ru(III) (edta)(H_2O) by $Ru(CN)_64$; H.C. Bajaj and A. Das; Polyhedron, 1997, 16, 3851.
2. Metal α, ω-dicarboxylate complexes: 3, Synthesis, characterization and single crystalX-ray investigation of (tetrakis(2-methylimidazolo)(μ-diadipato)(dicobalt(II))) monohydrate; E. Suresh, M.M. Bhadbhade and K. Venkatsubramanian; Polyhedron (1997), 16, 3941.
3. Metal α, ω-dicarboxylate complexes 2. Catena Poly ((bis(imidizole-N^3)copper(II)di-μ-adipato(I-)-O1,O^6,O^6,O^1)); E. Suresh and Mohan M. Bhadbhade; Acta Crystallo. C53, 422, (1997).
4. Metal α, ω-dicarboxylate complexes: 1, Aqua (2,2′-bipyridyl-N-N′) malonato-O,O′)- Copper II monohydrate; E. Suresh and Mohan M. Bhadbhade; Acta Crystallo. C53, 193-195, 1997.
5. X-ray structure of 3,3-Dimethyl-N-nitroso-2-phenyldecahydroquinolin-4-one; A Thiruvalluvar, V. Parthasarathi, D. Natarajan, N. Bhavani and M.M. Bhadbhade; Acta Crystallo. C53, 1086, (1997).
6. Synthesis, Structural Characterization and Catalytic carbonylation of nitrobenzene to phenylurethane using palladium(II) 1, 1-phenanthroline diacetate complex; S.B. Halligudi, N.H. Khan, R.I. Kureshy, E. Suresh and K. Venkatasubramanian; J. Mol. Catal., 124, (1997), 147-154.
7. Metal α, ω-dicarboxylate complexes 3: Synthesis, characterization and single crystal X-ray investigation of (Tetrakis (2-Methylimidazolo)(μ-diadipato)dicobalt (II) monohydrate);

E.Suresh, Mohan M. Bhadbhade and K. Venkatasubramanian; Polyhedron, 16, 3941, 1997.

8. Enantioselective catalytic epoxidation of non-functionalized prochiral olefins by dissymmetric chiral complexes of Mn(II) and Ru (III) and metal ions II; R.I. Kureshi, N.H. Khan, S.H.R. Abdi, P. Iyer and A.K. Bhatt; J. Mol.Catal., 120 (1997), 101-108.

9. Synthesis, Physicochemical studies and aerobic enantioselective epoxidation of non functionalized olefins catalysed by new Co(II) chiral Salen complexes; R.I. Kureshy, N.H. Khan, S.H.R. Abdi, P. Iyer and A.K. Bhatt; J.Mol.Catal., 121, (1997), 25.

10. Chiral Ru(III) metal complex-catalysed aerobic enantioselective epoxidation of styrene derivatives with co-oxidation of aldehyde; R.I. Kureshy, N.H. Khan, S.H.R. Abdi and P. Iyer J.Mol.Catal., 124, (1997), 91.

11. Predominance of electron-withdrawing effect over angular strain in the metal promoted hydrolysis of 2,4,6-tris(2-pyridyl)1,3,5-triazine; Parimal Paul, Beena Tyagi, Mohan M. Bhadbhade and E. Suresh; J.Chem.Soc., Dalton Trans.; 1997, 2273.

12. Redox responsive Bi/Trinuclear complexes incorporating ferrocenyl unit: Synthesis, characterization, physicochemical studies and X-ray structure of $(C_5H_5FeC_5H_4CH{=}CHC_5H_4NCH_3)PF_6$ with mirror creating disorder; Amitava Das, H.C. Bajaj and M.M. Bhadbhade; J. Organ. Metallic Chem. 1997, 554-555.

13. Catalytic transformation of ethanol over microporous vanadium silicate molecular sieves with MEL structure (VS-2); S. Kannan, T. Sen and S. Sivasankar; Journal of Catalysis, 170, 1997, 304-310.

14. Interaction of aqua(HEDTA)Ru(III) complex with Orthophemenylenediamine in aqueous solution, D. Chatterjee and D. Srinivas, Ind.J.Chem., 1997 30A 956.

15. Kinetic and mechanism of oxygen atom transfer reaction in the formation of Ru(V) = OEDTA) complex; D. Chatterjee and H.J. Padhiyar, 1197, 30A 956, Ind. J. Chem.

16. Selective air oxidation of DMS to DMSO catalysis by aminopolycarboxylate Ru(III) complexes; D. Chatterjee, I.Mol.Cat., 1997, 127, 57.

17. Studies on adsorption of acid dye on clay based adsorbents; J. Bhatt, H.M. Mody and H.C. Bajaj; Clay Research, Vol. 15(2), 28-32, 1996. (Late publication of Journal).

18. Synthesis, structural characterization and catalytic carbonylation of nitro benzene to phenyl urethane using Pd(II)I, 10 phenanthroline diacetato complexes; S.B. Halligudi, N.H. Khan, R.I. Kureshy, E. Suresh and K. Venkatasubramanian; J. Mol. Catal., 124, (1997), 147.

19. Homogeneous catalysis of selective functionalisation of alkanes and alkenes by dioxygen; R.S. Shukla; Stud. Surface Science & Catalysis; 113 (1998), 897-905.

20. Copper(II)diethylenetriamine perchlorato complexes bridged through varying length of dicarboxylato spacers: Synthesis, characterization on EPR studies; P. Subramanian, Paresh C. Dave, Vinod P. Boricha and D. Srinivas; Polyhedron, 17, 4, 443 (1998).

21. Intervalence charge transfer and kinetic studies of new mixed valence binuclear complex, (edtaH)Ru (III)NCRa $(II)(Cn)_5)^{4-}$; H.C. Bajaj and Amitava Das, Polyhedron, 1997, 16, 3851.

22. Homologation of methanol catalysed by Mn(salen)Cl_2 complex encapsulated in zeolite Y; S.B. Halligudi, D. Chatterjee, D.B. Shukla and R.S. Somani; in "**Recent Advances in Basic and Applied Aspects of Industrial Catalysis** (Editors: T.S.R. Prasad Rao and G. Muralidhar) published by Elsevier, **Studies in Surface Science and Catalysis, Vol. 113, pp. 841-843m 1998.**

23. Properties and reactivity of polyaminocarboxylate complexes of ruthenium; D. Chatterjee; Coord. Chem. Rev., 1998, 168, 273.

Membrane Science & Technology:

24. Synthesis and characterisation of chromium selective porous condensate polymers; J.J. Trivedi, K.M. Popat, P.S. Anand and B.D. Dasare; Reactive and Functional Polymers 32 (1997), 249-55.

25. Studies on bipolar membrane - Part II - conversion of sodium acetate to acetic acid and sodium hydroxide; G.S. Trivedi, B.G. Shah, S.K. Adhikary, V.K. Indusekhar and R. Rangarajan. Reactive & Functional polymers; 32, 209-215 (1997).

26. Interfacially synthesised thin film composite RO membranes for seawater desalination; A. Prakash Rao, N.V. Desai and R. Rangarajan; J. Memb. Sci. 124, 263-272 (1997);

27. Synthesis of catalytically active polymer bound Mn(III) salen complexes for enantioselective epoxidation of styrene derivatives; R.I. Kureshy, N.H. Khan, S.H.R.Abdi and P. Iyer; J.Reactive Polymers, 34 (1997), 153.

28. Voltammetry of Ru(III) - EDTA - Hydrazine complexes at HMDE in aqueous solution; G. Ramachandraiah, B. Tyagi and R. Prakash; Bull. Electrochem, 1997, 13(7), 294-298.

29. Electormetric studies on the reduction behaviour of Schiff base derivatives in different alcoholic media; C.J. Patil, A.S. Madhava, G. Ramachandraiah and D.N. Vyas; Bull. Electrochem, 1997, 13 (8-9), 370-379.

30. Electro-assisted transport phenomenon of strong and weak electrolytes across ion-exchange membranes: Chronopotentiometric study on deactivation of anion exchange membrane by higher homologous mono-carboxylates ; G. Ramachandraiah and P. Ray; The Journal of Physical Chemistry 1997, 101, 7892-7900.
31. Inorganic membranes: New materials for separation technology; A. Prakash Rao, N.V. Desai and R. Rangarajan; J. of Scientific & Ind. Res., Vol. 56, Sept. 1997, pp 518-522.

Biosalinity:

32. Effect of salinity and desiccation on carpospore liberation in Asparagopsis Delile Montagn (Rhodophyta, Bonnemaisoniales), Ganesan M and P.V.S. Rao; I. J. Marine Science; 26:, 312-314,1997.
33. Amino acids of some marine green algae of Okha coast; M.J. Dave and R.G. Parekh. Seaweed Res. Utiln. 19 (1&2); 21-26, 1997.
34. Amino acid composition of Caulerpa taxifolia; M.J. Dave, R.G.Parekh and E.R.R. Iyengar; Seaweed Research Utilisation, Vol. 17 (No.1 & 2), 1997.
35. Amino acids of some marine green algae of Okha Coast; M.J.Dave and R.G.Parekh; Seaweed Res. & Utl., 19(1&2), 21-24,1997.
36. Fatty acid content in seaweeds from the Baltic Sea and the Indian Ocean; B.K. Ramavat, K. Pazdro, Kosakowska A and Pempkoviak; J. Oceanologia, 39(3); 279-287, 1997.
37. Chemistry and Biology of Herbal Medicine, Value added marine flora; A.K. Siddhanta, O.P. Mairh and P. Natarajan; (Eds: V.P. Agarwal and V.P. Khamboj), Society of Bioscience, Muzaffarnagar, India, 1997, pp. 163-174.
38. Chemistry and Biology of Herbal Medicine; Biomass of promising alginophytes on Indian coasts; S.H. Zaidi, O.P. Mairh, (Eds: V.P. Agarwal and V.P. Khanboj), Society of Bioscience, Muzaffarnagar, India 1997, pp 113-130.
39. The seaweed resources of India; O.P. Mairh, C.R.K. Reddy and G. Raja Krishna Kumar (Eds: Alan T. Critchley and Masao Ohno), Japan International Agency, Japan, 1998 pp. 110-126.
40. Chapter for the Handbook on Crop Stress Physiology, Crop responses to salt stress - Seawater application and prospect; M.P. Reddy and E.R.R. Iyengar; edited by M.M.Passarachi.

PAPERS PRESENTED IN SEMINAR/CONFERENCE/ SYMPOSIA

Inorganic Chemicals:

1. Photocatalytic degradation of acrylamide,; N.N.Rao and S. Dube (accepted as a poster/oral presentation in 7th ACC held in Hiroshima, Japan during 16-20 May, 1997.
2. Computational investigations on orientation distribution of magnetic particles in lane layers of magnetic fluids; Pragna Bhatt, R.V. Mehta and D. Srinivas; Abstract sent for International Symposium on Hydrodynamics of Magnetic liquids and its application held at Institute of Fluids Sciences, Tohoku university, Sendar, Japan held during Sept. 1997.
3. Effect of size distribution of ferrofluids configuration : A Monte Carlo simulation; Pragna Bhatt, R.V. Mehta, S.P. Bhatnagar, R.V. Upadhyay and D. Srinivas; Abstract sent for the symposium on Recent Trends in Science and Technology of Magnetic Fluids held during Oct. 16-18, 1997 at Dept. of Mathematics, Narmada College of Science and Commerce, Zadeshwar, Bharuch.
4. Acidity of pillared clays; R.S. Somani, presented in the 13th National Symposium on Catalysis held at IIP, Dehradun during April 2-4, 1997 .
5. Incorporation of anionic copper pathalocyanine complexes into the intergallery of Mg-Al layered double hydroxides; S. Kannan; presented in the 13th National Symposium on Catalysis held at IIP, Dehradun during April 2-4, 1997.
6. Modification of texture and surface basicity of alumina by chemical treatment; R.V. Jasra; presented in the 13th National Symposium on Catalysis held at IIP, Dehradun during April 2-4, 1997.
7. Enantioselective epoxidation of prochiral non-functionalized olefins catalysed by Co(II) chiral shiff base complexes : Synthesis and physicochemical studies; N.H. Khan; presented in the 13th National Symposium on Catalysis held at IIP Dehradun during 2-4 April, 1997.
8. Homologation of methanol catalysed by Mn(salen) Cl_2 complex encapsulated in zeolite Y; S.B. Halligudi, D. Chatterjee, D.B. Shukla and R.S. Somani; presented in the 13th National Symposium on Catalysis held at IIP Dehradun during April 2-4, 19997.
9. Effect of polyvinyl alcohol and competitive ion-exchange method on surface properties of Alumina Pillared Clay (APC); H.M. Mody, H.C. Bajaj and P.Natarajan, ZMPC'97 Interna-

tional Symposium on Zeolite and Microporous Catalysis, held in August, 1997, Tokyo, Japan.

10. Development and commercialization of zeolite-A detergent grade builder through bauxite leachate route; R.S. Somani, P.M. Oza, M.R. Gandhi, C.R. Mishra, M.M.Seth and P. Natarajan; ZMPC'97 International Symp. on Zeolite and Microporous Crystals, held in August, 1997 in Tokyo, Japan.

11. Chiral Mn(III) Schiff base complex catalysed aerobic enantioselective epoxidation of prochiral non-functionalized olefins; R.I. Kureshi, N.H. Khan, S.H.R. Abdi and P. Iyer; Poster presentation in National Workshop in Catalysis held in RRL Trivandrum during 11-13 Dec., 1997.

12. Aerobic asymmetric epoxidation of prochiral non-functionalized olefins catalyzed by chiral salen Mn(III) complexes synthesis and characterization; N.H. Khan, S.H.R. Abdi and P. Iyer; Poster presentation In symposium on Modern Trends in Inorganic Chemistry held in IIT Kanpur during 4-6 Dec., 1997.

13. Kinetic and electrochemical aspects of two electron reduction of ferrofluid by Vitamin C in dilute aqueous solution; R.S. Shukla, G. Ramachandraiah and R.P. Pant; submitted for presentation in the Symposium on Recent Trends in Science and Technology of Magnetic Fluids held at Dept. of Mathematics, Narmada College of Science & Commerce; Zadeshwar, Bharuch on Oct. 16-18, 1997.

14. First electrochemical evidence for the metal transferring of electrons from the source to the NN Triple bonds of bound dinitrogen under moderately high pressure; G. Ramachandraiah and R. Prakash; submitted for oral presentation in the Natioanl Workshop on Catalhysis held during 11-13 Dec., 1997 at RRL Trivandrum.

15. Preparation of voltammetric characterisation of metal modified cationic membranes; V.K. Shahi, G. Ramachandraiah, R. Rangarajan and D.Vasudevan; submitted for presentation at the Sixteenth Conference on Council of Chemists held at Mangalore Univ., Mangalagangothri, Mangalore, Dec. 29, 1997.

16. Alkylation of benzene with 1-dodecane catalyzed by alumina pillared clay; S.D. Bhatt; H.M. Mody; H.C. Bajaj and R. V. Jasra; presented in National Workshop on Catalysis held at RRL Trivandrum in December, 1997.

17. Metal induced hydrolysis of 2,4,6-tris(2-pyridyl)1,3,5-triazine potential uses of new complexes in electrocatalytic reduction CO_2; P. Paul, B. Tyagi, A.D.Bilakhiya, M.M. Bhadbhade and E. Suresh; presented in the symposium on Inorganic Chemistry, held at IIT Kanpur during 4-6, Dec. 1997.

18. Redox responsive Bi/Trinuclear complexes incorporating ferrocenyl Unit; Synthesis, characterization, physicochemical studies and X-ray structure of $C_5H_5FeC_4H_4CH{=}CHC_5H_4NCH_3)PF_6$ with mirror creating disorder; Amitava Das, H.C. Bajaj and M.M. Bhadbhade, presented in conference on Modern Trends in Inorganic Chemistry held at IIT Kanpur during 4-6 Dec., 1997.

19. Asymmetric epoxidation of prochiral non-functionalized olefins catalyzed by chiral Ru(II) Schiff base complexes; R.I. Kureshi, N.H. Khan, S.H.R.Abdi and P. Iyer, paper contributed for poster/oral presentation in National Symposium on Metallorganics held on February 20-21, 1997 at Dept. of Chemistry, Indian Instt. of Technology,

20. ESR studies on Ferrofluids; R.V. Upaddhyay, R.V. Mehta and D.Srinivas,presented in the symposium on Recent Trends in Science and Technology of Magn. Fluids held at Dept. of Mathematics; Bharuch on 16-18 Oct., 1997.

21. FT-IR and electronic spectral investigation on metalloporphyrins and their cation radicals; Paresh C. Dave and D. Srinivas; Abstract communicated for 67th Annual Session of the National Academy of Science; Bhubaneswar; held on 24-26 Oct., 1997.

22. Studies on thermochromic behavior in copper-N,N,N',N'-tetraalkylethylene diamine complexes; Beena Narayanan, Y.R. Gohil and M.M. Bhadbhade; presented in the Poster Session of the VII Symp. on Modern Trends in Inorganic Chemistry, IIT, Kanpur during 4-6 Dec., 1997.

23. Novel Zig-zag and two dimentional polymeric networks involving Cu(II) metal centre and , D-dicarboxylic acid: EPR and single crystal investigations; E. Suresh, M.M. Bhadbhade and D. Srinivas; presented in the Poster Session of the VII Symp. on Modern Trends in Inorganic Chemistry held at IIT, Kanpur during 4-6 Dec., 1997.

24. Studies on the thermochromic behavior of copper and nickel complexes with diaza macrocycles; Y.R. Gohil and M.M. Bhadbhade; presented in the Poster Session of the VII Symp. on Modern Trends in Inorganic Chemistry held at IIT, Kanpur during 4-6 Dec., 1997.

25. Electronic spectra, ESR and electrochemical studies for cation radicals of substituted tetraphylporphyrins; Paresh C. Dave and D. Srinivas; presented in the Poster Session of the VII Symp. on Modern Trends in Inorganic Chemistry held at IIT, Kanpur during 4-6 Dec., 1997.

26. Alternate routes for the synthesis of detergent grade Zeolite 'A'; R.S. Somani, P.M. Oza, M.R. Gandhi and S.D. Gomkale, presented at the Silver Jubilee Congress CHEMCON-97, IIChE, New Delhi, 14-18 Dec., 1997.

27. Synthesis, characterization, electrochemical and photophysical studies of homo/hetero dinuclear complexes of Ru

and Os(II) with new dinucleating spacers having complete conjugations between the chromophores, National Symposium on Metallorganic, February 20-21, 1998, IIT, Madras.

28. 1H and 13C Spin Lattice Relaxation Studies and Conformational Dynamics in Substituted Salen Compounds; P.S. Subramanian and D. Srinivas; presented at National Symp. on Magnetic Resonance held at IISc., Bangalore during Feb. 4-7, 1998.

29. Electronic Structure of Copper(II) Tetraphenyl Porphyrins and their ! cation radicals : An ESR Study; Paresh C. Dave and D. Srinivas, presented at the National Symp. on Magnetic Resonance held at IISc., Bangalore during Feb. 4-7, 1998.

Membrane Science & Technology:

30. Synthesis characterization of novel aromatic poly(amide-imide)s with alternate (amide-amide) and (imide-imide) sequences; A.V.R. Reddy, P.S. Reddy and P.S. Anand; presented in the National Seminar on Advances in Polymer Science, held at Chennai on 21st July, 1997.

31. Chronopotentiometric investigation of the effects of size charge and nature of the ion and the co-ion on the transport phenomenon of the anion-exchange membrane; P. Ray, T.V. Tathak, K. Sarangi and G.Ramachandraiah; submitted for presentation to the International Conf. on Disperse Systems held at Jadavpur Univ., Dept. of Chem. Eng., Calcutta during 19-21, February, 1998.

32. Chronopotentiometric investigations of dialytic properties of glycine across ion-exchange membranes; V.K. Shahi, P. Ray, G. Ramachandraiah and R.Rangarajan; submitted for presentation at the National Symp. on Recent Trends in Membrane Transport held at BHU, Varasani on February, 19-20, 1997.

33. Membrane separation technology for refining vegetable oils - A feasibility study; Kripal Singh and V.J. Shah; presented at the XV IMS Conference held at CGCRI, Calcutta.

34. Membrane based vegetable oils refining process - a feasibility study; V.J.Shah and Kripal Singh; presented during International Seminar on "World Scenario in Oils, Oiochemicals and Surfactant Industries; held on April 10-12, 1998 at the Tajmahal Hotel, Lucknow.

35. Research on Desalination by Electrodialysis at CSMCRI; S.K. Adhikary; presented at the International Conf. on Disperse Systems, held on Feb. 19-21 at Calcutta.

36. Application of bipolar membranes for effluent treatment; G.S. Trivedi, B.G.Shah, S.K. Adhikary and R. Rangarajan; presented at the International Conf. on Disperse System held on Feb. 19-21, 1998 at Calcutta.

37. Electrocatalytic activation and reduction of N-N bonds in aqueous solution; R.Prakash and G. Ramachandraiah; presented at the 13th National Symposium on Catalysis Society, April 2-4, 1997, Indian Institute of Petroleum, Dehradun.

38. Low pressure polyamide thin film composite membranes by interfacial polymeriz-ation; A.V. Rami Reddy; Manomolecules - New Frontiers, IUPAC International Symposium on Advances in Polymer Science and Technology, Jan 5-9, 1998, CLRI, Chennai.

Biosalinity:

39. Calcineurin increases salt tolerance and photosynthesis in transgenic tobacco; M.P.Reddy; accepted for presentation in the International Conference on Frontiers in Biotechnology held at RRL, Trivandrum on 26-29th Nov., 1997.

RECRUITMENTS, TRANSFERS, RETIREMENTS, RESIGNATIONS, PROMOTIONS

New Recruitments:

Name	Designation	Date of joining
Shri Ashish S. Badheka	L.D.C., Hindi	20-06-1997
Shri Vishal J. Gohel	Jr.Stenographer	04-7-1997

Assessment Promotions:

Name	Promoted as	With effect from
Shri K.D. Padia	Scientist 'F'	06/12/1995
Shri A. Tiwari	Scientist 'F'	30/11/1995
Shri V.M. Sheth	Scientist 'F'	20/11/1995*
Shri J.B. Pandya	Scientist E.II	22/04/1995
Dr. M.P. Reddy	Scientist E.I	24/04/1995
Dr.(Mrs.) R.I. Kureshi	Scientist 'C'	24/04/1995
Shri R.B. Thorat	Scientist 'C'	04/03/1995
Shri A.K. Saha	Tech. Officer 'C'	16/12/1995
Dr. J.G. Bhatt	Tech. Officer 'A'	07/04/1994
Dr.(Mrs.) Beena Tyagi	Tech. Officer 'A'	26/04/1994
Shri A.B. Boricha	Tech. Officer 'A'	08/11/1994
Shri M.R.Rajyaguru	Tech. Officer 'A'	01/05/1995
Shri K.K. Das	Tech. Officer 'A'	12/07/1995
Shri Ch. Ravi Prakash	Group III (2)	20/11/1994
Shri P.D. Maru	Group III (2)	28/08/1994
Mrs. Charulata H. Vohra	Group III (2)	04/01/1995
Shri M.L. Bhatt	Group II (5)	27/02/1993
Shri P.N. Gohil	Group II (4)	27/02/1995
Shri P.R. Jadav	Group II (4)	01/02/1995
Shri B.B. Parmar	Group II (4)	01/02/1995
Shri B.B. Solanki	Group II (4)	01/02/1995@
Shri K.J. Anjara	Group II (4)	01/02/1995
Shri H.V. Solanki	Group II (4)	01/02/1995
Shri S.H. Kalsaria	Group II (4)	27/02/1995
Shri S.G. Chauhan	Group II (4)	01/02/1995
Shri A. Sathaku	Group II (4)	01/02/1995
Shri V.K. Bhatt	Group II (4)	27/02/1996
Shri H.M. Pandya	Group II (4)	01/04/1995
Shri N.R. Baraiya	Group II (4)	01/04/1995
Shri S.G. Devmorari	Group II (4)	01/02/1996
Shri H.M. Dhamal	Group II (4)	27/02/1996
Shri K.K. Dodia	Group II (4)	01/02/1996
Shri V.J. Mehta	Group II (4)	17/08/1995
Shri J.N. Parmar	Group II (4)	26/08/1995
Shri M.C. Parmar	Group II (4)	01/02/1996
Shri K.R. Patel	Group II (4)	01/02/1996
Shri T. Tankachan	Group II (4)	17/08/1995
Shri L.M. Kachadia	Group II (4)	02/08/1995
Shri S.N. Patel	Group II (4)	25/11/1995
Shri K.R. Gody	Group II (3)	26/03/1995
Shri A.M. Chauhan	Group II (3)	02/01/1995
Shri B.P. Rathod	Group II (3)	01/04/1994
Shri J.M. Parmar	Group II (3)	27/03/1995
Shri D.H. Khokhar	Group II (3)	25/10/1994
Shri R.P. Trivedi	Group II (3)	20/04/1994@
Shri D.R. Parmar	Group II (3)	20/05/1994
Shri M.N. Makwana	Group II (3)	27/08/1995
Shri H.H. Patel	Group II (3)	01/04/1995
Shri D.B. Solanki	Group II (3)	01/09/1995
Shri D.B. Valodara	Group II (3)	30/08/1995
Shri C.V. Trivedi	Group II (3)	01/02/1996
Shri K.C. George	Group II (3)	22/08/1995
Shri P..N. Rao	Group II (3)	25/01/1996
Shri S.D. Gohil'	Group II (2)	22/04/1995
Shri A.H. Lakhani	Group II (2)	22/06/1995
Shri B.A. Bhatti	Group II (2)	04/07/1995

Shri P. Adhikari	Group II (2)	03/10/1995
Shri N.J. Jani	Group II (2)	21/06/1996
Shri V. Ranga	Group I (4)	31/07/1995
Mrs. R.U. Pathan	Group I (2)	29/09/1994
Shri J.L. Chauhan	Group I (2)	17/07/1995
Mrs. A.A. Habibani	Group I (2)	05/10/1995
Shri J.B. Kanada	Group I (2)	05/10/1995
Mrs. S. Malika	Group I (2)	26/10/1995
Shri A.J. Vaghela	Group I (2)	17/08/1995
Shri M. Venugopal	Group V A(3)	30/04/1995
Shri M.P. Makwana	Group V A(2)	28/08/1994

*Voluntarily retired on 29-02-1997

@ Posthumous

Retirements:

Name of the Employee	Designation	Date
Dr. V.K. Indusekhar	Scientist 'F'	30/09/1997
Dr. R.G. Parekh	Scientist E.II	31/08/1997
Dr. O.K. Srivastava	Scientist E.I	30/06/1997
Dr. S.J. Tarwade	Scientist E.I	31/10/1997
Shri M.R. P. Nair	Scientist C	28/02/1998*
Shri S.L. Bhatt	Tech.Officer B	30/09/1997
Shri J.J. Palania	Technician	30/11/1997
Shri D.K. Modi	Assistant	31/01/1998

* Voluntary retirement

STAFF STRENGTH

Category	As on 31st March 1998		
	Ceiling	On Roll	Vacancies
Scientific:			
Group IV	116	96	20
Technical:			
Group III	59	48	11
Group II	113	101	12
Group I	31	29	2
Group V	4	3	1
Non-Technical:			
Officers	13	10	3
Establishment	65	46	19
Group D	36	28	8
Total	437	361	76

Research Fellows:

Research Associates	03
S.R.F.	10
Project Assistants	18

BUDGET (Rs. in lakhs)

	Rs. lakhs
Recurring	
Salaries & allowances	448.949
Contingency	51.653
Maintenance	15.372
Chemicals, consumables & other research expenditure	44.235
Total recurring	**560.209**
Capital	
Works & services	16.863
Apparatus & Equipments	19.526
Workshop machinery	0.027
Office equipment	3.985
Furniture & fittings	2.087
Library books	51.838
Vehicles	3.995
Total capital	98.321
Modernisation	50.000
Grand Total	708.530
External Cash Flow (ECF)	**Rs. 111.96 lakhs**

RESEARCH COUNCIL (Upto 31-12-1997)

Prof. R. Kumar, Dept. of Chemical Engineering, Indian Institute of Science, C.V. Raman Avenue, BANGALORE. 560012.	Chairman
Shri Kishore Mariwala, President - ICMA, C/o Bombay Oil Industries Ltd. L.B.S. Marg, Bhandup, MUMBAI. 400078	Member
Dr. S.G.T. Bhatt Indian Petrochemicals Corpn. Ltd., R&D Centre Petrochemical P.O., VADODARA-391346.	Member
Prof. V. Krishnan Dept. of Physical & Inorg. Chemistry Indian Institute of Science\ C.V.Raman Avenue BANGALORE- 560012.	Member
Shri R. Prakash, Office of Salt Commissioner 2-A, Lavan Bhavan, P.B. No.139, Lavan Marg, Jhalana Dongari, JAIPUR.	Member
Dr. (Mrs.) Manju Sharma, Secretary, Dept. of Biotechnology, Block - 2, 7th Floor, CGO Complex, Lodi Road, NEW DELHI 110 003.	Member
Dr. T. Ramaswamy, Director, Central Leather Res. Institute, Adyar, MADRAS 600020.	Member
Dr.S.A.H. Abidi, Director, Central Institute of Fisheries Education, Seven Bungalows, Versove, MUMBAI - 400 061	Member
Dr. S.D. Gomkale Acting Director CSMCRI, BHAVNAGAR 364 002	Member (w.e.f. 01/03/1997)
Shri S.N. Ghosh Scientist E-II CSMCRI, BHAVNAGAR- 364 002	Secretary

RESEARCH COUNCIL (w.e.f. 01/01/1998)

Prof. V. Krishnan Dept. of Physical & Inorg. Chemistry Indian Institute of Science C.V. Raman Avenue, BANGAORE 560012	Chairman
Shri Rajju Shroff CMD, United Phosphorus Ltd. Madhu Park, 11th Road, Khar (W), MUMBAI 400 051.	Member
Shri Kaushal Goel CMD, Hindustan Salts Ltd. B-427 Pradhan Marg Malaviya Nagar, JAIPUR 302017.	Member
Dr.G. Subramanian Director, National Facility for Marine Cyanobacteria Bharatidasan University, TIRUCHIRAPALLI-620 024 (T.N.).	Member
Dr. B.M. Mishra Head, Desalination Division Bhabha Atomic Research Centre Trombay, MUMBAI - 400085.	Member
Dr. V. Sampath Director, Dept. of Ocean Development Mahasagar Bhavan, Block 12, CGO Complex, Lodi Road, NEW DELHI 110 003.	Member
Dr. Sushil Kumar Director, Central Institute of Medicinal & Aromatic Plants P.O. CIMAP, LUCKNOW - 226015 (UP).	Member
Shri R.R. Hirwani Scientist F National Chemical Laboratory, PUNE - 411 008.	Member (DG's Nominee)
Dr. S.D. Gomkale Acting Director CSMCRI Bhavnagar-364002	Member
Shri S.N. Ghosh Scientist E-II CSMCRI Bhavnagar - 364 002.	Secretary

MANAGEMENT COUNCIL (Upto 31-12-1997)

Dr. S.D. Gomkale Acting Director CSMCRI, Bhavnagar - 364002	Chairman
Dr. V.K. Indusekhar, Sceientist F CSMCRI, Bhavnagar - 364 002	Member
Dr.S.T. Zodape Scientist C CSMCRI, Bhavnagar - 364 002	Member
Shri R.N. Parlikar Scientist G Indian Institute of Chemical Technology Upppal Road, HYDERABAD - 500007.	Member
Dr. M.D. Zingde Scientist-in-Charge Regional Centre of NIO (Goa) Seven Bungalows Versova, MUMBAI- 400 061.	Member
DGSIR or his nominee (permanent invitee)	Member
Sr. F&AO/F&AO CSMCRI, Bhavnagar - 364 002.	Member (Ex-officio)
Controller of Administration/ Administrative Officer CSMCRI, Bhavnagar - 364 002.	Member Secretary

MANAGEMENT COUNCIL (W.E.F. 01-01-1998)

Dr. S.D. Gomkale Acting Director CSMCRI, Bhavnagar-364 002	Chairman
Dr. R.V. Jasra Scientist F, CSMCRI, Bhavnagar.	Member
Dr.N.V. Desai, Scientist E.II CSMCRI, Bhavnagar.	Member
Shri M.R. Gandhi Scientist E.II. CSMCRI, Bhavnagar	Member
Dr.S.H. Zaidi, Scientist C, CSMCRI, Bhavnagar.	Member
Dr.M.D. Zingde, Scientist-in-Charge, NIO Regional Centre, MUMBAI.	Member
Dr.K.N. Maiti Scientist-in-Charge CGRI Naroda Centre AHMEDABAD.	Member
DGSIR or his nominee	Permanent invitee
Sr. F & AO/F & AO, CSMCRI	Member
Controller of Admn./ Administrative Officer, CSMCRI	Member-Secretary