वार्षिक प्रतिवेदन
ANNUAL REPORT
1986-87

राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान, नेहरू मार्ग, नागपुर - 440 020,
NATIONAL ENVIRONMENTAL ENGINEERING RESEARCH INSTITUTE
NEHRU MARG, NAGPUR-440020, INDIA

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राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान

नेहरू मार्ग, नागपुर - 440 020

NATIONAL ENVIRONMENTAL ENGINEERING RESEARCH INSTITUTE

NEHRU MARG, NAGPUR - 440 020

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– समीक्षा –

राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान, वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद के अधीन एक स्वायत्त संस्था है और पर्यावरण विज्ञान तथा इंजीनियरी में अनुसंधान और विकास कार्यों में महत्व पूर्ण भूमिका निभाती है। संस्थान पर्यावरण संबंधी वर्तमान और भावी समस्याओं के समाधान ढूंढने में प्रयत्नशील है। पर्यावरणीय समस्याओं को योजना प्रक्रिया का अंतरंग अंग मानते हुए संस्थान के अनुसंधान कार्य मुख्यत: आर्थिक विकास को पर्यावरण के अनुरुप बनाने के उद्देश्य से वैज्ञानिक और प्रौद्योगिक साधनों के विकास की दृष्टि से किये जाते हैं।

संस्थान के अनुसंधान और विकास कार्यों में निम्नलिखित का विकास और प्रचार–प्रसार प्रमुख है :–

1. वायु, जल, भूमि और जैव प्रदूषण की मात्रा की सही–सही गणना के लिए विश्लेषण तकनीकें;
2. किफायती शहरी और ग्रामीण जल-पूर्ति और स्वच्छता पद्धतियां;
3. उद्योगों के तरल और गैसीय कचरे (बहि:स्राव) के प्रबंध की सस्ती प्रौद्योगिकी, जिसमें आर्थिक रूप से उत्पादक संसाधनों के पुन:चक्रण और पुन:उपयोग की देसी प्रणालियों को महत्व दिया जाता है;
4. शहरी और उद्योगों के ठोस कचरे के प्रबंध के लिए किफायती नियंत्रण प्रौद्योगिकी;
5. कार्य–कारण सह–संबंधों के पूर्वानुमान के लिए आवश्यक साधनों के विकास की दृष्टि से पर्यावरणीय प्रणालियों के प्रतिरुप तैयार करना;
6. पर्यावरणीय समस्याओं के व्यावहारिक और कम से कम लागत वाले समाधान ढूंढने के लिए पर्यावरणीय पद्धतियों का इष्टतम उपयोग;
7. बड़ी–बड़ी विकास परियोजनाओं के प्रभाव का मूल्यांकन जिसमें इन प्रभावों का पता लगाना, पूर्वानुमान, और वायु, जल, भूमि, जैविक और सामाजिक तथा आर्थिक पर्यावरण पर पडने वाले महत्वपूर्ण प्रभावों के मूल्यांकन के साथ–साथ पर्यावरण प्रबंध योजनाओं का विकास भी शामिल है;
8. पर्यावरण संबंधी सूचना और आंकडे;
9. पर्यावरण प्रदूषण निवारण और नियंत्रण नीति की रूप रेखा;
10. निजी और सार्वजनिक क्षेत्र के उपक्रमों के लिए विशेष प्रशिक्षण पाठ्यक्रम।

प्रदूषण नियंत्रण के लिए ऐसी देशी, सस्ती, आर्थिक रूप से उत्पादक प्रौद्योगिकी का विकास और प्रचार जिसका प्रचालन और रख-रखाव आसान हो, जिससे भारत के पर्यावरण संरक्षण कार्यक्रम प्रदूषणकारियों द्वारा स्वीकार्य हों, नीरी का सबसे महत्वपूर्ण योगदान है।

वर्ष 1986-87 में नीरी मे 60 अनुसंधान और विकास योजनाओं पर कार्य किया गया जिनमें दो राष्ट्रीय मिशन, 35 वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद् की आंतरिक परियोजनाएं और पर्यावरण, वन एवं तन्य जीव विभाग, भारत सरकार, नई दिल्ली; केंद्रीय जल प्रदूषण नियंत्रण मण्डल; नगर निगम; उद्योग और सामुदायिक जल पूर्ति और स्वच्छता विषय अंतर्राष्ट्रीय संदर्भ केंद्र और डेनिश अंतर्राष्ट्रीय विकास एजेन्सी जैसी राष्ट्रीय और अंतर्राष्ट्रीय एजेंसियों द्वारा 23 प्रायोजित सहयोगी कार्यक्रम शामिल हैं।

शहरी और ग्रामीण जल-पूर्ति और स्वच्छता पद्धतियों के सस्ते डिज़ाइनों का विकास और मूल्यांकन, पुर्नगठन की दृष्टि से वर्तमान पद्धतियों का आकलन और दुर्लभ पीने योग्य पानी की बचत के लिए वितरण प्रणाली से पानी की बर्बादी की रोक-थाम तथा रख-रखाव की रणनीति तैयार कर अंतर्राष्ट्रीय पेय जल-पूर्ति और स्वच्छता दशक कार्यक्रम (1981-1990) के राष्ट्रीय लक्ष्यों की पूर्ति में "नीरी" द्वारा महत्वपूर्ण योगदान दिया गया है। अनुसंधान और विकास कार्यों में व्यावहारिक तथा न्यूनतम लागत वाले समाधानों पर विशेष बल दिया जाता है ताकि प्रचालन संक्रिया विज्ञान साधनों (ऑपरेशन रिसर्च टूल्स) की सहायता से उपलब्ध साज-सामान और वित्तीय संसाधनों से जनता की अधिक से अधिक सेवा की जा सके।

ग्रामीण जनता को पीने का साफ पानी उपलब्ध कराने के उद्देश्य से राज्य सरकारों द्वारा चलाए जा रहे त्वरित ग्रामीण जल-पूर्ति कार्यो के समर्थन में भारत सरकार द्वारा "ग्रामीण पेय जल तथा संबद्ध जल-प्रबंध प्रौद्योगिकी मिशन" कार्यक्रम आरंभ किया गया। पर्याप्त मात्रा में पीने योग्य पानी की सुनिश्चित व्यवस्था करने के लिए ग्रामीण जल-पूर्ति योजनाओं को कम खर्चीला और अधिक कार्यकुशल बनाने के इस सामाजिक लक्ष्य की पूर्ति के लिए नीरी के अनुभव से लाभ उठाया जा रहा है।

गंगा की सफाई और प्रदूषण की रोकथाम के एक अन्य सामाजिक लक्ष्य की पूर्ति में भी स्वास्थ्य से संबंधित दु:साध्य और विषालु प्रदूषक, कीटनाशी, पी.सी.वी., पी. ए. एच. और भारी धातुओं आदि कारकों के विषय में संस्थान के ज्ञान और अनुभव का लाभ उठाया जा रहा है। इन विषयों पर किए गए अनुसंधान कार्यों से प्राप्त आधारभूत आंकड़ों की सहायता से नियामक एजेंसियां प्रदूषण स्रोत पर ही नियंत्रण उपाय कर सकेंगी। वाराणसी में कूड़े-कचरे (ठोस अपशिष्ट) के प्रबंध की दीर्घ-कालीन योजना पर संस्थान की सिफारिशें केंद्रीय गंगा प्राधिकरण को दी गई।

खारे पानी की समस्या से ग्रस्त गांवों में पीने का पानी उपलब्ध कराने के लिए पानी से लवण दूर करने से संबंधित अनुसंधान के बड़े पैमाने पर अनुप्रयोग के उद्देश्य से भारत सरकार द्वारा एक कार्यकारी दल गठित किया गया था जिसकी सलाह पर केंद्रीय लवण और समुद्री रसायन अनुसंधान संस्थान, भावनगर द्वारा दो-दो व्युत्क्रम परासरण (रिवर्स ऑसमोसिस) और वैद्युत अपोहन (इलेक्ट्रो डायलिसिस) संयंत्र; भाभा परमाणु अनुसंधान केंद्र, बम्बई द्वारा दो व्युत्क्रम परासरण संयंत्र और रक्षा अनुसंधान प्रयोगशाला, जोधपुर द्वारा दो वैद्युत अपोहन संयंत्र लगाए गए। 'नीरी' द्वारा आंध्र प्रदेश, गुजरात, तमिलनाडु और राजस्थान के गांवों में लगाए गए इन संयंत्रों के मूल्यांकन के बाद एक व्यापक रिपोर्ट प्रस्तुत की गई। इन अध्ययनों के आधार पर व्युत्क्रम परासरण और वैद्युत अपोहन द्वारा विलवणीकरण की आवर्ती लागत क्रमशः 9 से 31 रु. प्रति घन मीटर और 8 से 24 रु. प्रति घन मीटर आती है।

फ्लुओराइड निवारण की राष्ट्रीय परियोजना के अंतर्गत संस्थान द्वारा 1984 में कदिरी (आंध्र प्रदेश) में 22.70 लाख ली. प्रति दिन क्षमता का एक बड़ा फ्लुओराइड निवारण संयंत्र लगाया गया और उसका कार्यक्षमता मूल्यांकन संबंधी अध्ययन पूरा किया गया। संयंत्र की कार्यक्षमता संतोषजनक थी और उपचारित जल में फ्लुओराइड की मात्रा भी निर्धारित सीमा के अंदर थी।

सचिव, पर्यावरण विभाग, भारत सरकार के अनुरोध पर 'नीरी' द्वारा लक्षद्वीप की पर्यावरणीय समस्याओं पर एक प्राथमिक रिपोर्ट प्रस्तुत की गई। यह आम धारणा है कि भूजल स्रोतों के अविवेकपूर्ण दोहन के कारण इन द्वीपों के जल में लवण की मात्रा निरंतर बढ़ती जा रही है। इन द्वीपों के किसी भी जलस्रोतों में लवण की मात्रा संबंधी आंकड़े उपलब्ध नहीं हैं। संस्थान द्वारा किए गए समस्या के गहन अध्ययन से संकेत मिला है कि बिटरा द्वीप के अतिरिक्त अन्य जल स्रोतों में घुले लवणों की मात्रा इतनी अधिक नहीं है कि उस पानी का उपयोग न किया जा सके।

लक्षद्वीप में मछली और नारियल संसाधन के परिणाम स्वरूप उत्पन्न ठोस कचरे से अनेक पर्यावरणीय समस्याओं का सामना करना पड़ता है। संघ शासित क्षेत्र लक्षद्वीप में ठोस अपशिष्ट प्रबंध के सुधार के लिए संस्थान द्वारा सर्वेक्षण का काम पूरा किया गया।

बड़ी–बड़ी विकास योजनाओं के पर्यावरणीय प्रभाव के मूल्यांकन द्वारा पर्यावरणीय समस्याओं को आर्थिक विकास प्रक्रिया का अभिन्न अंग बनाने के महत्वपूर्ण कार्य में संस्थान की अग्रणी भूमिका रही है। विकास परियोजनाओं के वायु, जल, भूमि, जैविक तथा पर्यावरण के सामाजिक और आर्थिक घटकों पर अच्छे और बुरे प्रभावों के गणनात्मक मूल्यांकन पर बल दिया जाता है ताकि विकास माध्यम, प्रक्रिया प्रौद्योगिकी और परियोजना स्थल के विकल्पों के संबंध में निष्पक्ष निर्णय लेने में सुविधा हो। अभी तक पेट्रोल, कोयला, उर्वरक आदि उद्योग, ताप–बिजली घरों और गोदी न्यासों (पोर्ट ट्रस्ट) के लिए संस्थान द्वारा पर्यावरणीय प्रभावों का मूल्यांकन किया गया है।

निर्णय प्रक्रिया में प्रदूषक उद्योगों को सहयोगी बनाने के उद्देश्य से "नीरी" द्वारा ठोस, तरल और गैसीय अपशिष्ट (व्यर्थ–पदार्थ) प्रबंध पद्धतियों के लिए न्यूनतम राष्ट्रीय मानक (MINAS) तैयार कर गैसीय और तरल बहि:स्रावों के मानक निर्धारित करने की प्रक्रिया में भी संस्थान ने उल्लेखनीय कार्य किया है।

संस्थान के प्रदूषण नियंत्रण संबंधी अनुसंधान और विकास कार्य में देश का संपूर्ण औद्योगिक क्षेत्र शामिल है। "नीरी", उद्योगों की वर्तमान और भावी पर्यावरणीय समस्याओं का पता लगाकर सस्ते हल सुझाने की चुनौती का सामना करने को तैयार है।

संस्थान द्वारा हैदराबाद और सिकंदराबाद में वर्ष 1991 में अनुमानित वाहित–मल के उपचार की विस्तृत योजना तैयार की गई। यह योजना हैदराबाद नगर निगम द्वारा प्रायोजित थी। नगर निगम को दी गई रिपोर्ट में हैदराबाद में वाहित-मल उपचार पद्धति को नया रूप प्रदान करने का अंतिम चरण शामिल है।

मद्रास के सबसे बडे और भारत के सबसे पुराने चमडे के कारखाने मे. क्रोम लेदर कंपनी के अपशिष्ट–जल के निपटान संबंधी अध्ययनों के बाद प्रस्तावित उपचार इकाईयों के प्रवाह चित्र और इंजीनियरी विवरण सहित रेखाचित्र प्रदान किए गए।

कांडला पोर्ट, गुजरात के अनुरोध पर संस्थान द्वारा गांधीग्राम, आदिपुर और कांडला में घरेलू वाहित–मल उपचार संयंत्रों का डिजाइन तैयार किया गया। इन संयंत्रों का डिज़ाइन सन 1991 की अनुमानित जनसंख्या के लिए तैयार किया गया है। "नीरी" द्वारा हिंदुस्तान ऑर्गेनिक केमिकल्स लि., रसायनी में अनेक प्रकार के प्रतिस्थापित सुगंधित यौगिक बनाने वाली इकाईयों के अपशिष्टों के उपचार के लिए संयंत्र का डिज़ाइन तैयार कर एक संयंत्र लगाया गया।

अन्य विषयों के अतिरिक्त, जैव प्रौद्योगिकीय उपचार विधि से दु:साध्य और विषालु अपशिष्टों के प्रबंध पर भी इस समय अनुसंधान जारी है। फिनॉल, सायनाइड, सुगंधित और अन्य दु:साध्य पदार्थों की अधिक मात्रा वाले औद्योगिक बहि:स्रावों के सस्ते उपचार के लिए सूक्ष्म जीवाणुओं की विशेष प्रजातियों का पता लगाकर उनका व्यापक स्तर पर संवर्धन किया गया है। इस अनुसंधान के परिणाम स्वरूप निम्न ताप-क्रम पर कोयले का कार्बनीकरण, कोकभट्टियों, अफीम क्षारोद (एल्कलॉयड) फिनॉल फॉर्मलडिहाइड और बिरोजा (रेजिन) बनाने वाली औद्योगिक इकाइयों के लिए व्याव-हारिक व्यर्थ–जल उपचार पद्धतियों के डिज़ाइन तैयार किए गए। अत्यधिक खतरनाक व्यर्थ–जल के सुरक्षित निपटान के लिए पिघले नमक की दहन और पिघले शीशे की भस्मीकरण (इनसिनरेशन) प्रक्रियाओं पर अनुसंधान जारी है।

संस्थान द्वारा फिनॉलयुक्त विषालु औद्योगिक अपशिष्टों तथा क्षेत्रीय अनुसंधान प्रयोगशाला, हैदराबाद और कोल केमिकल कंप्लैक्स, नसपुर, आंध्र प्रदेश के निम्न तापक्रम कार्बनिकरण संयंत्र में कोयले के कार्बनीकरण/गैसीकरण संयंत्रों के इसी प्रकार के दूसरे प्रदूषणकारी तत्वों के उपचार के लिए प्रयोगशाला में सुरक्षित सुक्ष्मजीव

संवर्धनों को जैव उत्प्रेरकों के रूप में उपयोग करने की तकनीक विकसित की गई है। इन संयंत्रों के प्रयोगशाला के **केंडिडा ट्रॉपिकेलिस** संवर्धनों का उपयोग किया गया।

अप्रेल 1986 में संस्थान में 16/32 संकेतों वाले अतिसूक्ष्म सी. एम. सी. इम्पेक्ट 8640 संगणक लगाया गया जिसे हैवलैट पैकार्ड 9050 ए. एम. ग्राफिक केंद्र से जोड़ दिया गया। इस प्रकार संस्थान इस समय मध्य भारत में सर्वाधिक विकसित संगणक केंद्र के रूप में कार्य कर रहा है।

संस्थान द्वारा हर साल पर्यावरण प्रबंध के विभिन्न पक्षों से संबद्ध 12 प्रशिक्षण पाठ्यक्रमों का आयोजन किया जाता है। विशिष्ट उद्योगों के अनुरोध पर उनकी आवश्यकता के अनुसार भी पाठ्यक्रम आयोजित किए जाते हैं। दक्षिण पूर्व एशिया क्षेत्र के लिए प्रशिक्षण पाठ्यक्रमों के आयोजन में संस्थान को डेनिडा, और विश्व स्वास्थ्य संगठन आदि अंतर्राष्ट्रीय एजेंसियों का सहयोग प्राप्त है।

अनुसंधान संबंधी प्रकाशनों और प्रशिक्षण कार्यक्रमों के माध्यम से सूचना का प्रचार-प्रसार संस्थान की सबसे महत्वपूर्ण गतिविधि समझी जाती है। प्रकाशनों में एक अनुसंधान गृह-पत्रिका, विभिन्न प्रौद्योगिकियों की तकनीकी जानकारी, टेकनीकल डाइजेस्ट, न्यूजलैटर तथा सूचना प्रसारण के लिए अनेक लोकप्रिय विज्ञान लेख और दृश्य-श्रव्य साधन सम्मिलित हैं।

संस्थान विश्व स्वास्थ्य संगठन से संबद्ध अंतर्राष्ट्रीय पर्यावरणीय सूचना केंद्रों की केंद्रीय एजेंसी, संयुक्त राष्ट्र पर्यावरण कार्यक्रम (नेरोबी), जल अनुसंधान केंद्र (इंग्लैंड), स्वच्छता सूचना केंद्र (बैंकाक) वायु प्रदूषण तकनीकी सूचना केंद्र (स. रा. अमरीका), ठोस अपशिष्ठ सूचना पुन:उद्धरण प्रणाली (प. जर्मनी) तथा स्वच्छता इंजीनियरी और पर्यावरण विज्ञान का पैन अमरिकन केंद्र (पेरु) का सहयोगी केंद्र है।

1986-87 में संस्थान का स्थापना दिवस (8 अप्रैल, 1986), विश्व पर्यावरण दिवस (5 जून, 1986), पर्यावरण गुणता दिवस (9 दिसंबर, 1986), विश्व स्वास्थ्य संगठन द्वारा प्रायोजित दुर्घटना प्रबंध विषयक अंतर्राष्ट्रीय कार्यशाला (14-17 अक्टूबर, 1986) और राष्ट्रीय विज्ञान दिवस (27 फरवरी 1987) संस्थान के महत्वपूर्ण आयोजन थे।

1986-87 में संस्थान के भरे हुए कुल 586 पदों में 165 वैज्ञानिक और 234 सहायक तकनीकी कर्मचारी थे। इस वर्ष संस्थान को वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद् से 300.963 लाख रु. का अनुदान मिला और प्रायोजित परियोजना और अन्य स्रोतों से 137.496 रु. प्राप्त हुए।

पु० ख०ना०

(पुरुषोत्तम खन्ना)
निदेशक

OVERVIEW OF INSTITUTE'S ACTIVITIES

The National Environmental Engineering Research Institute (NEERI) is an autonomous body under the Council of Scientific and Industrial Research and plays a leading role in Research and Development in Environmental Science and Engineering. The Institute's programme continues to evolve in answer to existing and emerging environmental concerns. The major fields of investigation are oriented to develop scientific and technological tools to bring about compatibility between ecology and economics by inter-analysing environmental concerns in the process of planning for economic development.

The prominent areas of scientific and technical research at NEERI relate to development and dissemination of :

- Analytical techniques for precise quatification of pollutants in air, water, land and biological environment
- Cost-effective rural and urban water supply and sanitation systems
- Cost-effective technology for management of liquid and gaseous industrial effluents with emphasis on financially productive and indigenous resource recycle and reuse systems
- Cost-effective control technology for management of urban and industrial solid wastes
- Environmental systems modelling to devise predictive tools for cause-effect relationships
- Environmental systems optimization with a view to identifying functional and minimal cost solutions to environmental problems
- Environmental impact assessment of major developmental projects incorporating identification, prediction and evaluation of significant impacts on air, water, land, biological and socio-economic components of environment as also development of management plans
- Environmental information and data base systems
- Framework for preventive environmental policy
- Training packages for specific public and private sectors

The most significant contributions of the Institute relate to development and dissemination of indigenous, cost-effective, financially productive and easy-to-operate-and-maintain technology for pollution control systems thereby achieving polluter-acceptability to the environment preservation programmes in India.

During 1986–87, NEERI was engaged in 60 R&D programmes including two National Missions, 35 Inhouse Projects and 23 Sponsored and Collaborative programmes from National and International agencies. These agencies are, Department of Environment, Forests and Wildlife, Government of India; Central Pollution Control Board; Municipal Corporations; Industries and International organisations including WHO, International Reference Centre on Community Water Supply and Sanitation and Danish International Development Agency.

The Institute has actively participated in achieving the National requirement for International Drinking Water Supply and Sanitation Decade (1981–1990) by assessing existing systems with a view to reorganising the same, evolving and evaluating cost-effective designs for urban and rural water supply and sanitation systems and devising preventive maintenance strategies to conserve scarce potable water. The emphasis has been on the synthesis of functional and minimal cost solutions to maximize service to the people in available financial and material resources with recourse to operations research tools.

To supplement the efforts of State Governments in accelerated rural water supply programme to provide safe drinking water to the village population, Government of India launched 'Technology Mission for Drinking Water in Villages and Related Water Management'. NEERI is actively contributing its experience to this Societal Mission to improve the performance and cost effectiveness of the rural water supply schemes to ensure adequate quantity of drinking water of acceptable quality.

Prevention of Pollution and Cleaning of River Ganga is yet another Societal Mission where the Institute is contributing its knowledge and experience on health related parameters like hazardous and recalcitrant pollutants, pesticides, PCBs, PAHs and heavy metals. Data from these investigations provide baseline information that will enable the regulatory agencies to take corrective measures at the source. Detailed recommendations on long term planning for solid waste management at Varanasi was submitted to Central Ganga Authority.

A Working Group on large scale practical application of water desalination research to provide potable water to villages affected by salinity was constituted by Government of India. On the advice of the Group, CSMCRI, Bhavnagar installed two each of R. O. and E. D. plants; BARC, Bombay two R. O. plants and DRL, Jodhpur two E. D. plants. NEERI completed the evaluation of these plants installed in the villages of Andhra Predesh, Tamil Nadu, Gujarat and Rajasthan and submitted a comprehensive report. On the basis of these studies, the recurring cost of desalination by R. O. and E. D. ranges from Rs. 9 to Rs. 31; and Rs. 8 to 24; respectively per m^3.

A large scale defluoridation plant (2.27 MLD) was installed by NEERI in 1984 at Kadiri in Andhra Pradesh. The Institute completed the perform-

ance evaluation of this plant, as a part of National Project on Defluoridation. The plant performance was satisfactory and fluoride concentration in the treated water was within the permissible limit.

At the instance of the Secretary, Department of Environment Government of India, NEERI submitted a preliminary report on the environmental aspects of Lakshadweep Islands. It is the general apprehension that salinity of water in these islands is continuously increasing because of indiscriminate exploitation of ground water resources. There is no record of salinity values of any of the sources in these islands. Most comprehensive study on this aspect was conducted by NEERI and observations indicate that there are water sources with acceptable dissolved salts in all islands except Bitra.

The Institute has completed a survey for the improvement of Solid Waste Management in the Union Territory of Lakshadweep, where solid waste generated due to the processing of fish and coconut pose numerous environmental problems.

One of the pioneering activities of the Institute relates to environmental impact assessment of major developmental projects thereby inter-analysing environmental concerns in the process of economic development. The emphasis is on quantification of favourable and adverse impacts of the projects on air, water, land, biological and socio-economic components of environment to facilitate objective decision-making on alternative routes for development, process technologies and project sites. The sectors covered include petroleum, coal, fertilizer, thermal power plants and port trusts.

The Institute has also developed technology ranking matrices for gaseous, liquid and solid waste management systems to ensure polluter participation in the decision making process. It has also contributed significantly to the process of establishment of effluent standards for gaseous and liquid wastes in India. A case in point is the Minimal National Standards for small paper and pulp mills.

The R&D endeavour of the Institute in pollution control encompasses the entire spectrum of industrial sector in the country. The challenge, that the Institute has accepted, is to identify the existing and prospective environmental problems of the industries and devise cost-effective solutions.

A detailed scheme has been provided for the treatment of sewage for the twin cities of Hyderabad for the output expected in the year 1991. The project was sponsored by the Municipal Corporation of Hyderabad. The report covers the final phase of 'Remodelling of Sewage Treatment Systems for Hyderabad'.

Treatment flow sheets with semi-detailed engineering drawings have been provided for the proposed treatment units after completing studies on disposal of wastewaters from M/s Chrome Leather Company, Madras which is one of the largest and oldest tannery in India.

At the request of Kandla Port Trust, Gujarat, the Institute has provided the desing for sewage treatment plants for treatment of domestic sewage at Gandhidham, Adipur and Kandla. These plants have been designed for population upto the year 1991. NEERI has designed and commissioned a demonstration plant for the treatment of wastes which include a variety of substituted aromatic compounds at Hindustan Organic Chemicals Limited, Rasayani.

One of the current areas of Institute's R & D relates to the management of recalcitrant and hazardous waste through biotechnological routes. Specific microbial strains have been isolated and mass culture for cost-effective treatment of effluents bearing high concentration of phenols, cyanides, aromatics and other recalcitrant multi-substrates. These investigations have resulted in the design of functional wastewater treatment systems for low temperature carbonization coal and coke oven plants, opium and alkaloid and phenol-formaldehyde resin manufacturing industrial units. The Institute is presently researching on molten salt combustion and molten glass incineration systems for safe disposal of hazardous wastewaters.

The technical know-how has been developed for the use of laboratory stored microbial cultures as bio-catalysts for the treatment of toxic industrial waste containing phenols and other related pollutants from coal carbonization/ gasificatian plant at Regional Research Laboratory, Hyderabad, and the LTC plant at Coal Chemical Complex, Naspur, Andhra Pradesh. These full-scale treatment plants were seeded with laboratory stored cultures, *Candida tropicalis*.

NEERI has the most advanced Computer Work-station in Central India. It has a 16/32 bit Super Micro CMC Impact 8640 which is combined with an Hewlett Packard 9050 AM Graphics.

The Institute offered a package of twelve training programmes related to various facets of environmental management. Custom-made and industry-specific training programmes were organised on request from specific sectors. International agencies like DANIDA and WHO collaborate with NEERI in organising regional (South-East Asia) training programmes.

One of the most valued activities relate to information dissemination through research, publications and training programmes. The publications are an in-house research journal, technical digests, news-letters and a host of popular articles and audio-visual aids for information dissemination.

NEERI is a collaborating centre and nodal agency in international environmental information networks accredited to World Health Orgnization (Geneva), United Nations Environment Programme (Nairobi), Water Research Centre (England), Environmental Sanitation Information Centre (Bangkok), Air Pollution Technical Information Centre (USA), Solid Waste Information Retrieval System (West Germany) and Pan American Centre for Sanitary Engineering and Environmental Science (Peru).

During the year 1986–87, the Institute observed : Foundation Day (April 8, 1986), World Environment Day (June 5, 1986), Environment Quality Day (December 9, 1986), National Science Day (February 27, 1987) and collaborated in organising WHO International Workshop on Disaster Management (October 14–17, 1986).

The total number of posts filled up as in 1986–87 was 586, including 165 scientists and 234 supporting technical staff. During the year the Institute received its grants of Rs. 300.963 lakhs from CSIR. The receipts from sponsored projects and other deposits were Rs. 137.496 lakhs.

(P. KHANNA)
DIRECTOR

LIST OF PROJECTS

Air Pollution Control

1. National air quality monitoring network
2. Formulation of emission factors with and without control equipment for scheduled industries and optimization analysis of respective major control equipments
3. Study of ecophysiological responses of regional plant species to the pollutants emitted by fertilizers and refineries
4. Development of testing of high efficiency scrubbing system for combustion boilers for simultaneous absorption of SOx and NOx
5. Assessment of stack and fugitive emission and impact on neighbourhood air quality M/s. Ferro-Alloys Corporation Ltd.
6. Monitoring of stack emissions at Hindustan Zinc Ltd. Smelter, at Debari, Udaipur & its impact on neighbourhood air quality and land use

Water Quality

7. Large scale practical application of water desalination with a view to provide safe drinking water to areas affected by salinity problem
8. Field testing of a package water treatment plant
9. Development of simplified spectrophotometric procedures for estimation of manganese and zinc in drinking water
10. Development of field testing ampoules for potable waters
11. Studies on mercury in water
12. Development and optimization of liquid chromatographic techniques for hazardous trace organic pollutants in drinking water
13. Optimization of GC–MS technique for the estimation of N–Nitroso compounds in water
14. Technology mission on drinking water in villages and related water management

Water Engineering

15. Improvement in efficiency of unit processes in water treatment with reference to rapid mixing in flocculation process

16. Bench-scale sudies on recovery of alum by liquid ion exchange (LIE) technique

17. Field testing of a package water treatment plant

18. Slow Sand Filtration (SSF)-Phase IV

19. Pilot project on Preventive Maintenance of Water Distribution System with reference to waste assessment, leak detection and control at Trivandrum (Kerala)

20. Performance evaluation of water treatment plants in India

21. Performance evaluation of water distribution systems of seven selected cities in India

22. Development and testing of direct reading electric network analyzer for the analysis of existing water distribution system

23. Preventive maintenance of water distribution system at Trivandrum

Waste Water Engineering

24. Anaerobic suspended bed reactor & anaerobic biological drum contactor for treatment of high organic strength wastewater (A comprehensive study)

25. Treatment of dairy waste by rotating biological drum-contactor and anaerobic upflow fixed film reactor (A comprehensive study)

26. Water quality evaluation of Jamuna River upstream and down stream of Mathura Refinery effluent outfall

27. Integrated environmental pollution control system with energy recovery in Hindon basin

28. Rheological behavior of sludges

29. Performance evaluation of industrial waste water treatment plant

30. Reuse of sewage effluents for general industrial use of municipal corporation of Bhavnagar

31. Studies, evaluation and revamping of treatment plant for rubber chemical wastes

32. Studies on high organic wastewaters using aerobic and anaerobic systems

33. Studies on utilisation of activated carbon for removal of heavy metals from industrial effluents

Recalcitrant Industrial & Hazardous Wastes

34. Toxic metals in environment – their effects, removal and disposal

35. Disposal of harzardous wastes by molten salt combustion technique

36. Treatment of wastewater from organic chemical industries containing high nitrate by combination of anoxic and aerobic methods

37. Prevention of pollution and cleaning of river Ganga

Life Sciences

38. Impact of normal plankton in the aquatic environment for removal of pollutants such as nitrates, phosphates, chlorinated hydrocarbons, organo-phosphorus pesticides and heavy metals

39. Prevalence of human entero–virus in sewage effluent at Nagpur

40. Control of mosquitoes by some aquatic plants

41. Virus removal and survival through sludges in various wastewater (pilot plant) systems

42. Impact of land application of wastewater on autochethonus soil microflora and their interaction with the organisms introduced through wastewater

43. Evaluation studies of air–borne micro–organisms to assess air quality in cities (Madras & Nagpur)

44. Resource recovery from pulp and paper mill solid wastes through biocon-version process

45. Use of bituminous coal for concentrating enteric viruses from water and wastewater

46. Microbial degradation of pesticides

47. Biological monitoring of water pollution :

    Phase I – Ciliated protozoa and algal colonization on artificial substrates for assessing aquatic environment

    Phase II – Effect of pesticides on algae

48. Microbial degradation of wastewater from coal carbonization & gasi-fication industries in treatment plants

Instrumentation

49. Comparative evaluation of different instrumental methods for detection and measurement of heavy metals in the environment

Technology Demonstration

50. Use of dissolved air flotation technique for solid-liquid separation in the treatment reuse and recycle of industrial wastes and sewage

51. Evaluation of an improved rotating biological rope contactor (RBRC) : Technology for waste water treatment

52. Determination of K_i the inhibition coefficient in activated sludge

Technology Utilization

53. Validity of BOD determination at higher temperatures

54. Field testing of iron removal kits

Environmental Impact Analysis & Consultancy

55. Laboratory studies on anaerobic fluidized bed for treatment of strong industrial organic waste such as distillery

56. Environmental impact analysis and assessment of prevailing pollution in Calcutta Port Trust area

57. Environmental impact study of MIDC industrial estate, near Bombay

Solid Waste Management

58. Aerobic treatment of cellulosic solid waste – Effect of some toxic organic and Inorganic substances

59. Anaerobic digestion of municipal solid waste

60. Planning for utilization of garbage and other waste materials of Lakshadweep

61. Studies on some environmental aspects of application of compost and sludge on land

Basic Research & Training

62. Speciation of Sulphur in Sulphurous water

63. Development and application of physico–chemical speciation schemes for assessment of environmental impact of heavy metals with special reference to chromium, cadmium, lead and mercury

64. Identification and quantification of colour causing components in distillery wastewater

Computer Applications

65. Development of Bivane

Completed Projects

1. NEERI–CSIR coordinated project on mines to metals & habitat
2. Treatment and disposal of wastewater from Chrome Leather Company, Madras
3. Design of sewage disposal system for Gandhidham and Kandla Port Trust townships
4. Remodelling of sewage treatment System, Hyderabad
5. Development of computerized data-handling system for manpower and project planning in environmental research
6. Solid Waste Management
7. Utilisation of solid wastes from Lakshadweep islands
8. Studies on contact stabilization using industrial wastewaters
9. Treatment of wastewater from the proposed monochrotophos pesticide plant of M/s. National Insecticides and Chemicals Ltd., Chandigarh.

LIST OF PUBLICATIONS

Periodicals :

- Indian Journal of Environmental Health
  Vol. 28, No. 2, 3, 4 (1986) & Vol. 29, No. 1 (1987)
- A Guide to Current Literature in Environmental Health Engineering and Science
  Vol. 17, No. 4 to 12 (1986) & Vol. 18, No. 1 to 3 (1987)
- Annual Report 1985-86

Booklets :

- NEERI's Contribution to the State of Uttar Pradesh (Hindi & English)
- NEERI in the Service of Rajasthan (Hindi & English)
- Orange City Environment
- Sanitation for Rural India
- NEERI in the Service of Nation

Course Manuals :

- Waste Water Treatment
- Water & Waste Water Analysis (Revised)

Documents :

- Project Summary Sheets (Completed Projects) 1985-86

Folders :

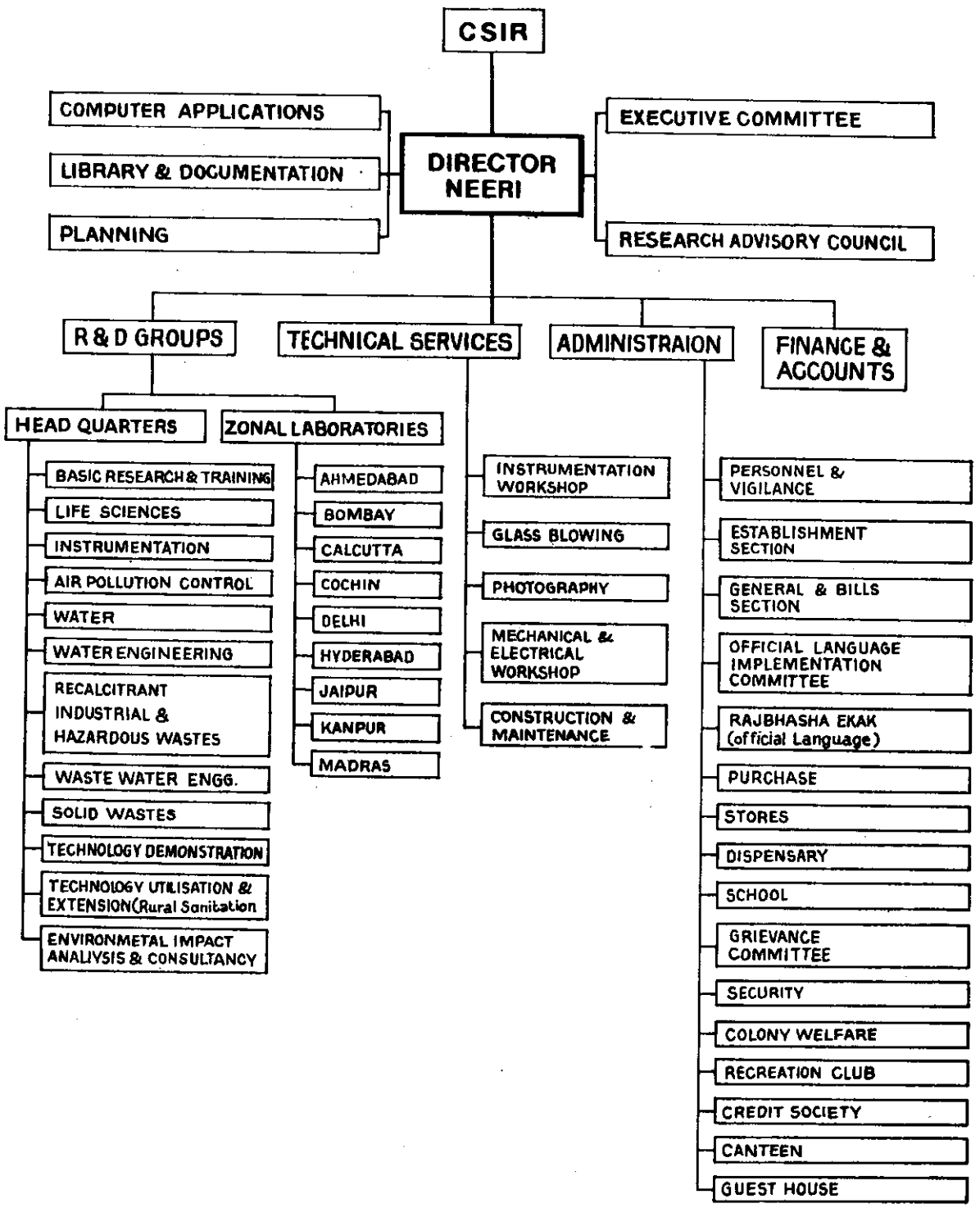
- NEERI Information
- NEERI Publications
- Defluoridation of Water by Nalgonda Technique
- Disinfection of Rural Water - Chlorine Tablets/Ampoules
- NEERI Pot Chlorinator for Rural Areas
- NEERI Provides Technology of Slow Sand Filtration for Rural Water Supply
- NEERI's Package Water Treatment Plant for Rural Water Supplies
- NEERI's Domestic Iron & Manganese Removal Unit for Rural Areas
- Water Distribution : NEERI's Contribution

HONOURS & AWARDS

* Dr. R. Sarin, Scientist & Head, Basic Research and Training Division, was awarded the coveted Eisenhower Exchange Fellowship Award for visiting the U. S. A. for three months in early 1987.

* Doctorate degree was conferred by Nagpur University on S/Shri V. P. Thergaonkar, S. D. Deshpande and S. D. Badrinath and by Bombay University on Shri R. K. Pandit for research in environmental science and engineering.

ORGANISATIONAL CHART



ACTIVITY GROUPS

1.0 **ANALYTICAL** (Inorganics : Organics : Analytical Quality Control : Automated Analysis; Sampling Procedures; Detection and Occurrance of water-borne bacterial and viral Pathogens; Fate and Effects of Environmental Pollutants; Speciation Studies, etc.).

2.0 **AIR** (Chemistry ; Meteorology ; Emissions, Effects ; Monitoring ; impacts on Terrestrial Ecology ; Abatement and Control – Industrial, Automobile and Domestic).

3.0 **WATER** (Surface, Ground, Municipal and Industrial ; Urban & Rural Water Supply ; Transmission & Distribution ; Disinfection ; Desalination ; Defluoridation ; Defferratisation ; Demineralisation ; etc).

4.0 **WASTEWATER** River water quality ; Municipal, Agricultural, Industrial and Mining Discharges from point-& non-point sources ; Reclamation and Reuse ; Energy Recovery ; eutrophication of Water Bodies) Land Application : Effects of Pollution on Fresh Water and Saline organics ; Aquatic Sediments, etc).

5.0 **SOLID WASTE MANAGEMENT** (Municipal; Mining; & Industrial & Sludges),

6.0 **ENVIRONMENTAL IMPACT STUDIES & RISK BENEFIT ANALYSIS** (Methodologies and procedures for incorporation in decision making process; Reviewing Environmental Assessment Reports of development proposals in various sectors; Assessment Programmes of case studies).

7.0 **INFRASTRUCTURE** (Computer Applications; Technology Transfer; Training International S & T Cooperation; Planning; Information; Publicity; Management, etc.)

FUNCTIONS OF EACH GROUP

* Development
* Monitoring
* Evaluation
* Control
* Modelling & Systems Optimisation
* Training

ACTIVITIES DURING 1986-87

AIR POLLUTION CONTROL

Studies on air pollution emission characterisation, impact assessment and control of point and fugitive emissions were carried for major industrial establishments. These include, Thermal Power Plants at Ropar and Korba, Pulp and Paper Mills at Amlai, Ferrous and Non-ferrous plants including Bhilai Steel Plant, and Hindustan Zinc Smelter, Udaipur.

Under the National Air Quality Monitoring Network (NAQMN) Programme, air quality of ten major cities is being regularly monitored. Additional parameters determined from April 1986 onwards are trace metals including Pb, Zn, Ni, Cd, Cu, As, Mn, and Hg, aromatic hydrocarbons and acid rain parameters.

Studies on ecophysiological responses of plant species to refinery and fertilizer emissions are being studied at Cochin.

The projects under study are :

Sr. No.	Project No.	Title
1.	AMA-01	National air quality monitoring network
2.	APC-04	Formulation of emission factors with and without control equipment for scheduled industries and optimization analysis of respective major control equipments
3.	APC-05	Study of ecophysiological responses of regional plant species to the pollutants emitted by fertilizers and refineries
4.	APC-06	Development and testing of high efficiency scrubbing system for combustion boilers for simultaneous absorption of SO_x and NO_x.

WATER QUALITY

The second phase of studies on performance evaluation of eight desalination plants installed in Tamil Nadu, Andhra Pradesh, Gujarat and Rajasthan was completed in November 1986. NEERI is one of the coordinating laboratories for the study on large scale practical application of water desalination with a view to provide safe drinking water to areas affected by salinity problems.

Under the National Project on Defluoridation, performance evaluation studies on full scale defluoridation plant (2.27 mld) has been completed. This project is a part of the National Technology Mission on Drinking Water.

Survey of water quality in nearly 400 villages in all has been completed under the first phase of the Technology Mission on Drinking Water in Villages and Related Water Management from five districts namely Kurnool (AP), Jhabua (MP), Gulbarga (Karnataka), Ramanathapuram (TN) and Gurgaon (Haryana).

Field testing ampoules known as "Ferro-ampoule" for iron and "Chrom-ampoule" for hexavalent chromium have been developed. These ampoules are useful for estimating iron and hexavalent chromium in waters from rivers, wells and the mining areas.

A method has been developed for the determination of trace amounts of chlorophenoxy acids and their esters in water under a programme of development and optimization of liquid chromatographic techniques for determination of hazardous trace organic pollutants in drinking water.

The projects under study are :

Sr. No.	Project No.	Title
1.	WC-03	Large scale practical application of water desalination with a view to provide safe drinking water to areas affected by salinity problem
2.	WC-04	Field testing of a package water treatment plant
3.	ATD-06	Development of simplified spectrophotometric procedures for estimation of manganese and zinc in drinking water
4.	ATD-07	Development of field testing ampoules for potable waters
5.	ATD-08	Studies on mercury in water
6.	ATD-09	Development and optimization of liquid chromatographic techniques for hazardous trace organic pollutants in drinking water
7.	ATD-10	Optimization of GC-MS technique for the estimation of N – Nitroso compounds in water

WATER ENGINEERING

A Pilot Project on Preventive Maintenance of Water Distribution System with reference to Waste Assessment, Leak Detection and its Control, has been completed at Ludhiana (Punjab).

An All-India Training Programme on Leak Detection and Preventive Maintenance of Water Distribution Systems was conducted at Srinagar (Jammu & Kashmir) during September

23 and October 3, 1986. The programme was sponsored by CPHEEO, Government of India, New Delhi.

The projects under study are :

Sr. No.	Project No.	Title
1.	WE-02	Improvement in efficiency of unit processes in water treatment with reference to rapid mixing in flocculation process
2.	WE-03	Bench-scale studies on recovery of alum by liquid ion exchange (LIE) technique
3.	WE-04	Field testing of a package water treatment plant
4.	WE-05	Slow Sand Filtration (SSF) – Phase IV
5.	WD-04	Pilot project on Preventive Maintenance of Water Distribution System with reference to Waste Assessment, Leak Detection and Control at Trivandrum (Kerala)
6.	WE-06	Performance evaluation of water treatment plants in India
7.	WE-07	Performance evaluation of water distribution systems of seven selected cities in India
8.	WE-08	Development and testing of direct reading electric network analyzer for the analysis of existing water distribution system

(a) A Workshop on "Slow Sand Filter Design & Construction" was jointly organised by NEERI and the International Reference Centre (IRC) for Community Water Supply & Sanitation, The Netherlands in New Delhi during January 19–21, 1987. About 20 senior design engineers from different States of India and from International Organisations like UNICEF, WHO and Danish International Development Agency, participated in the Workshop.

The Workshop was a part of the Research-cum-demonstration project on Slow Sand Filtration, being implemented by NEERI in collaboration with IRC, with a view to promote the application of this simple technology for purification of polluted surface waters especially in developing countries. Following the presentation of an overview of the slow sand filtration process and the purpose and design of SSF components, slow sand, filter design currently adopted by different states were critically reviewed and rational criteria for the cost effective design were formulated.

(b) Under the project 'Technology Mission on Drinking Water in Villages and Related Water Management', reports on Water Quality Assessment in (i) Gulbarga District (Karnataka State) and (ii) Ramanathpuram District (Tamil Nadu), have been prepared and submitted to respective Executive Directors and other concerned authorities.

WASTE WATER ENGINEERING

Studies have been completed on the 1 m^3/day capacity pilot plant for the treatment of distillery spent wash at Ajudhia Distillery Moradabad. Energy recovery from distillery spent wash treatment has been encouraging. Studies are continuing on Hindon Basin Project on Integrated Environmental Pollution Control with Energy Recovery.

The projects under study are :

Sr. No.	Project No.	Title
1.	WWE-01	Anaerobic suspended bed reactor & anaerobic biological drum contactor for treatment of high organic strength wastewater (A comprehensive study)
2.	WWE-02	Treatment of dairy waste by rotating biological drum – contactor and anaerobic upflow fixed film reactor (A comprehensive study)
3.	WWE-01/DZL	Water quality evaluation of Jamuna River up-stream and down-stream of Mathura Refinery effluent outfall
4.	WWE-03/DZL	Integrated environmental pollution control system with energy recovery in Hindon Basin
5.	WWE-02/HZL	Rheological behavior of sludges

RECALCITRANT INDUSTRIAL & HAZARDOUS WASTES

A major activity of the Division is the prevention of pollution and cleaning of the river Ganga under NEERI's Action Plan.

Based on bench-scale studies, on the biological treatment of basic organic chemical industry wastewater which contains a variety of substituted aromatics, a demonstration, plant adopting aerobic principles has been designed and commissioned by NEERI at Hindustan Organic Chemicals, Rasayani. Studies have been completed at HOC and the results obtained showed a COD, TOC, nitrobodies and BOD removal of around 77, 70 and 89 per cent respectively. The process is being scaled up based on the results obtained in the investigation.

The projects under study are :

Sr. No.	Project No.	Title
1.	RIHW-05	Toxic metals in environment – their effects removal and disposal
2.	RIHW-06	Disposal of hazardous wastes by molten salt combustion technique
3.	RIHW-07	Treatment of wastewater from organic chemical industries containing high nitrate by a combination of anoxic and aerobic methods

LIFE SCIENCES

The use of specialised microbes as biocatalysts in treating industrial wastes was successfully demonstrated in the treatment of toxic waste containing phenol from coal gasification plant at RRL, Hyderabad. The high concentration of phenol in the effluent could be brought well within permissible discharge limits with the help of microbial culture, *Candida tropicalis*.

Studies on degradation of cyanide waste by microbial cultures is being scaled up in pilot plant studies at Gujarat Alkaline Ltd., Baroda. Biological monitoring of water pollution is undertaken with a view to develop an inexpensive rapid method for monitoring of water quality.

The projects under study are :

Sr. No.	Project No.	Title
1.	LS–01	Impact of normal plankton in the aquatic environment for removal of pollutants such as nitrates, phosphates, chlorinated hydrocarbons, organophosphorus pesticides and heavy metals.
2.	LS–02	Prevalence of human entero–virus in sewage effluent at Nagpur
3.	LS–03	Control of mosquitoes by some aquatic plants
4.	LS–04	Virus removal and survival through sludges in various wastewater (pilot plant) systems.
5.	LS–05	Impact of land application of wastewater on autochethonus soil microflora and their interaction with the organisms introduced through wastewater
6.	LS–06	Evaluation studies of air–borne micro–organisms to assess air quality in cities (Madras & Nagpur)
7.	LS–07	Resource recovery from pulp and paper mill solid wastes through bioconversion process
8.	EM–04	Use of bituminous coal for concentrating enteric viruses from water and wastewater
9.	EM–08	Microbial degradation of pesticides
10.	EES–03	Biological monitoring of water pollution : Phase I – Ciliated protozoa and algal colonization on artificial substrates for assessing aquatic environment. Phase II – Effect of pesticides on algae
11.	LS–08	Microbial degradation of wastewater from coal carbonization & gasification industries in treatment plants.

INSTRUMENTATION

Studies have been completed on standardization of a method for the quantitative analysis of some sulphur compounds in air by gas liquid chromatography.

A semi-automatic sequential air sampler has been developed by using CMOS Integrated circuits and microprocessor technology.

Four new sophisticated analytical instruments have recently been installed in the Division, as a part of the Institute's Central Facility. These are : (i) Zeeman Atomic Absorption Spectrophotometer, "Hitachi" make Model Z-8000; (ii) Particle size analysis apparatus, Hiac-Royco make Model 4102; (iii) Ion Chromatograph - Dionex, USA make Model-2001; & (iv) Automatic Titratot-Mettler Model-DL-40RC.

The Division carries out repairs and maintenance of instruments at Headquarters and NEERI Zonal Laboratories. Over 15,000 samples were analysed by various sophisticated analytical instruments. The photographic section completed 910 jobs including preparation of slides, colour slides and photographs, diosochrome slides and photo-micrographic work. Eighty three jobs were completed by the glass-blowing section.

The Division assisted in organising a national training programme on Analytical Instrumentation in Environmental Engineering at the Institute on January 13-23, 1987.

Sr. No.	Project No.	Title
1.	INST-5	Comparative evaluation of different instrumental methods for detection and measurement of heavy metals in the environment

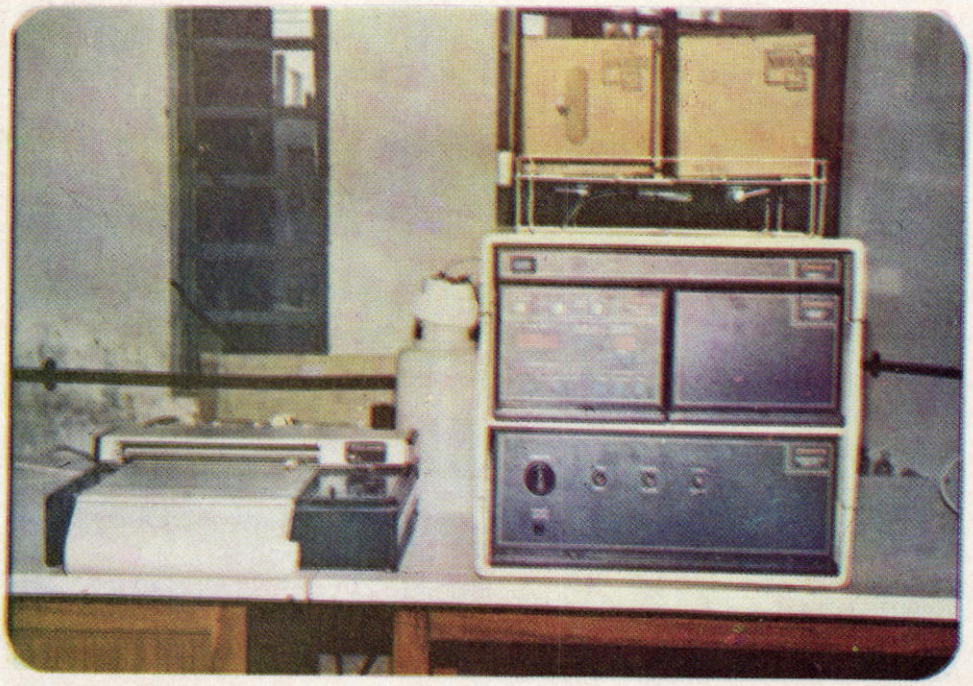
TECHNOLOGY DEMONSTRATION

The project, 'Mines to Metals and Habitat' was completed in May 1986. A design of water treatment plant was provided for ensuring safe drinking water at the chromite mines at Kaliapani, Orissa, where water contains excess of hexavalent chromium. The project was entrusted to NEERI by the CSIR Coordination Council (Engineering Group) during 1985-86. The Orissa Mining Corporation (OMC), Bhubaneshwar coordinated with CSIR laboratories involved in this project. The formulation and implementation of integrated development plans being done jointly by the Engineering Group of Laboratories of CSIR and OMC.

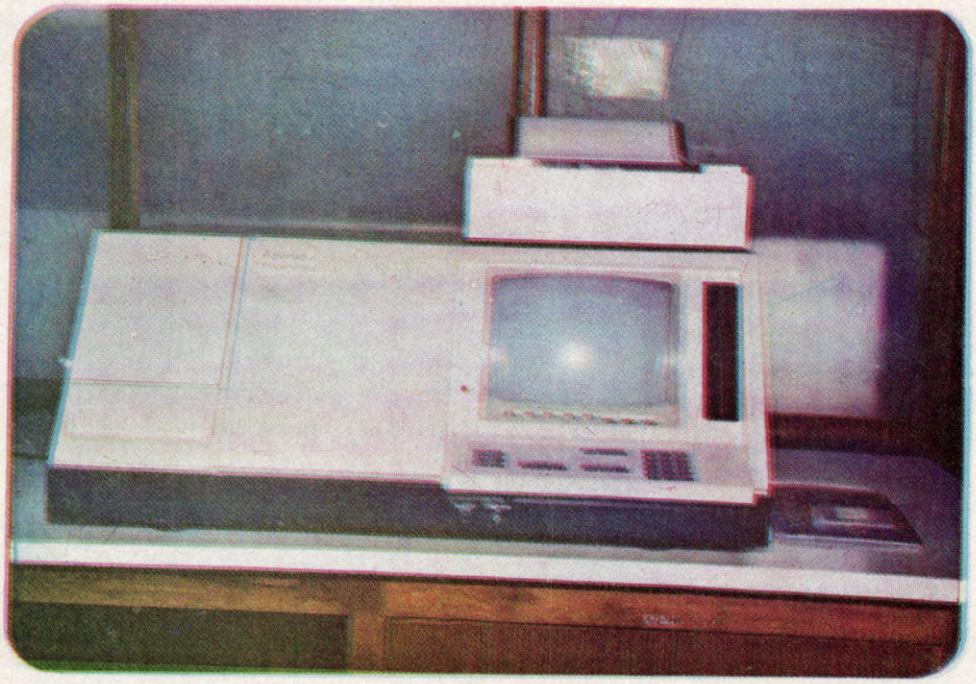
The projects under study are :

Sr. No.	Project No.	Title
1.	TD-01	Use of dissolved air flotation technique for solid-liquid separation in the treatment reuse and recycle of industrial wastes and sewage
2.	TD-02	Evaluation of an improved rotating biological rope contactor (RBRC) Technology for waste-water treatment
3.	TD-03	Determination of K_i the Inhibition Coefficient in activated sludge

Two installed sophisticated instruments at the Institute



Dionex Chromatography System



Fluorescence Spectrophotometer

TECHNOLOGY UTILIZATION

A survey was completed with special emphasis on iron removal problems in Tripura. It was observed that excessive iron from lateritic deposits was due to high concentration of CO_2. Different methods of treatment have been indicated in a preliminary report.

Evaluation of a type of flushing cistern given by World Bank Technology Advisory Group on Low Cost Sanitation was completed. It was observed that, with a few modifications, the cistern could be used.

A tape-slide programme on 'How to fabricate cement concrete wc pan and trap' has been prepared. After display in various training programmes in the neighbouring villages, it was realised that a great demand exists for such educational programmes. The trainees from local ITI have been trained in the fabrication of wc pans and traps.

The Central Pollution Control Board, New Delhi (erstwhile Central Board for Prevention and Control of Water Pollution) have proposed an extension of the project entitled "Validity of BOD determination at higher temperature". In the extended part of this project, analysis of replicate samples of chemicals, wastewaters and waters could be analysed for BOD at two temperatures, *viz*., 20° and 27°C at 3 days incubation.

Work has been initiated for utilization of waste land recovery by co-recycling of city refuse and mine rejects.

The Process Release Committee of the Institute has approved that Rotating Biological Rope Contactor, Dissolved Air Flotation, Pyrochar from paper mill sludge and Phenol Degradation, be commercially exploited either directly or through NRDC.

Dialogue has been initiated with M/s. Ballarpur Paper Mills, where it is proposed to install NEERI's proven technologies for scaling up of certain units and for demonstration of wastewater treatment technologies at one place.

The projects under study are :

Sr. No.	Project No.	Title
1.	TUE–01	Validity of BOD determination at higher temperatures
2.	TUE–02	Field testing of iron removal kits

ENVIRONMENTAL IMPACT ANALYSIS & CONSULTANCY

The major activity was the study on Environmental Impact Assessment of Ropar Thermal Power Plant, Ropar, sponsored by the Punjab State Electricity Board.

Studies are being carried out to evolve design criteria for full scale cyanide removal system for the treatment of wastes at Gujarat Alkalies & Chemicals Limited, Baroda.

Pilot plant studies on treatment of distillery wastes by anaerobic fluidised bed reactor system has been completed.

Several consultancy and sponsored research projects were completed. Notable among these were treatment and disposal of Dye Vat Effluents from Central Coir Research Institute, Coir Board, Alleppey. Studies on causes of corrosion and frequent breakdown of sewers in Ahmedabad City; Treatment and disposal of wastewaters from Chrome Leather Company, Madras; and Treatment of Wastewaters from the proposed Monochrotophos pesticide plant of M/s. National Insecticides and Chemicals Ltd, Chandigarh.

The projects under study are :

Sr. No.	Projects No.	Title
1.	EEC–04	Laboratory studies on anaerobic fluidized bed for treatment of strong industrial organic waste such as distillery
2.	WWE–I–07	Environmental impact analysis and assessment of prevailing pollution in Calcutta Port Trust area

SOLID WASTE MANAGEMENT

A detailed report on methods of utilization of various types of solid waste produced in Lakshadweep has been submitted to the sponsor, the Union Territory Authorities. The report provides economical methods of utilisation of coconut pith, fish waste and municipal solid waste.

Another indepth study was completed on Long-term Planning for Solid Waste Management at Varanasi. Specific suggestions have been incorporated in the report to improve the existing methods of collection, transportation and disposal and costs involved are also indicated. The report was submitted in August 1986 to the Central Ganga Authority, the sponsor of the study.

The projects under study are :

Sr. No.	Project No.	Title
1.	SW–03	Aerobic treatment of cellulosic solid waste – Effect of some toxic organic and inorganic substances
2.	SW–06	Anaerobic digestion of municipal solid waste
3.	SW–07	Planning for utilization of garbage and other waste materials of Lakshadweep
4.	SW–08	Studies on some Environmental aspects of application of compost and sludge on land

In addition to the above projects, the Division was also involved in the Environmental Impact Assessment of Ropar Thermal Power Project.

BASIC RESEARCH & TRAINING

Fourteen training courses were conducted during the year. Seven were sponsored by outside agencies, namely (i) Indian Petrochemicals Limited; (ii) Department of Environment, UP State Govt.; (iii) Oil & Natural Gas Commission; (iv) CPHEEO, Ministry of Urban Development, Govt. of India, New Delhi; (v) Hindustan Photofilms Limited; and (vi) Swedish Association for Technical Assistance, Nepal.

It was for the first time that NEERI conducted a course on Environment Management for officials of IAS cadre. The course was well received and appreciated. Several requests have been received for repeating such courses. In all, 259 persons from various State/Central Govt. agencies, Govt. of India Undertakings, State/Central Pollution Control Boards and Universities benefitted from the training courses. Six Fellows sponsored by WHO from South East Asian Countries, such as Nepal, Bangladesh, Afghanistan and Indonesia were imparted training in water supply and rural sanitation.

Other highlights of this year are two training programmes conducted for officials of nine Polytechnology Transfer Centres of CSIR and engineers of ten States on water treatment technologies developed by NEERI. This activity formed part of the Technology Mission on Drinking Water in Villages and Related Water Management (WTM).

The details of training courses conducted during 1986–87 are as follows :

Training Courses : 1986–87

Sr. No.	Course and Duration	No. of participants
1.	Bioassay July 24 to July 4, 1986	17
2.	Water & Wastewater Analysis July 14 to August 1, 1986	25
3.	Technology Awareness Programmes for Polytechnology Transfer Centre Officers of CSIR under Water Technology Mission August 1–4, 1986	10
4.	Physico–Chemical & Bacteriological Analysis of Water (sponsored by SATA, Nepal) August 4 to September 27, 1986	1
5.	Environment Management (at Baroda, sponsored by IPCL) August 11–18, 1986	25
6.	Technology Awareness Programme for State Engineers under Water Technology Mission August 25–26, 1986	14
7.	Environment Management (sponsored by UP State Dept. of Environment) September 2–7, 1986	19

8.	Air Quality Monitoring September 16–27, 1986	27
9.	Preventive Maintenance and Leak Detection in Water Distribution System (at Srinagar, sponsored by CPHEEO) September 23–30, 1986	27
10.	Wastewater Treatment October 15–29, 1986	19
11.	Enviroment Management (sponsored by ONGC) November 10–21, 1966	17
12.	Solid Waste Management (sponsored by CPHEEO) December 9–16, 1986	5
13.	Analytical Instrumentation in Env. Engineering January 13–23, 1987	28
14.	Effluent Treatment Plant Operators (at Ooty, sponsored by Hindustan Photofilms) January 20–22, 1987	25

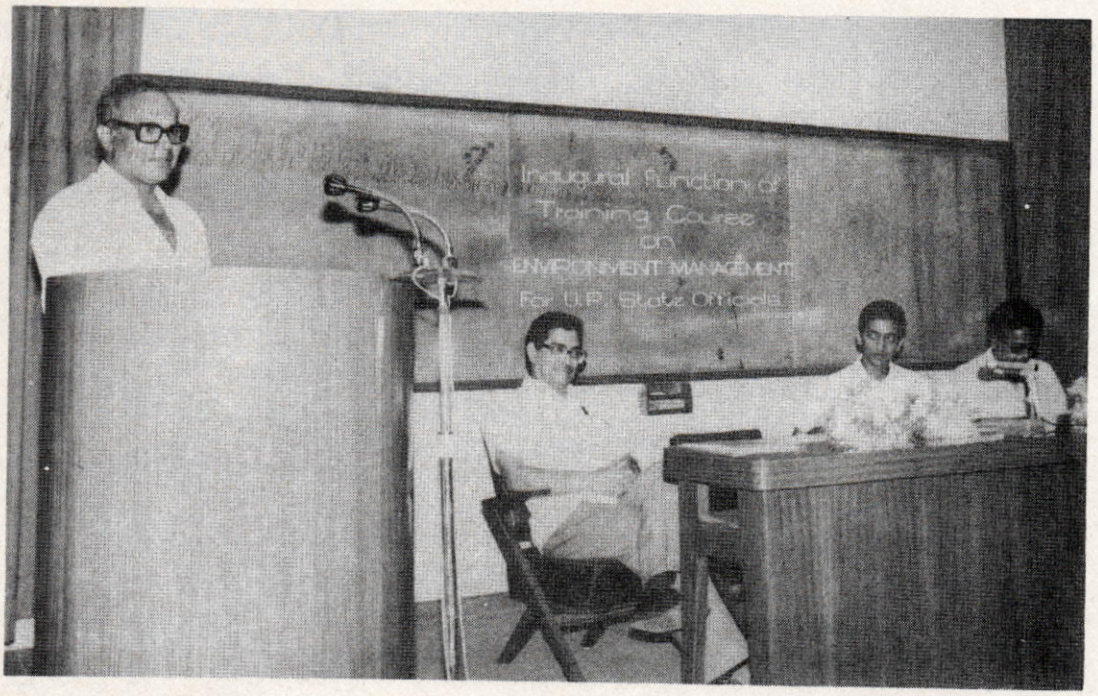
The projects under study are :

Sr. No	Project No.	Title
1.	BRT-01	Speciation of sulphur in sulphurous water
2.	BRT-02	Development and application of physico-chemical speciation schemes for assessment of Environmental Impact of Heavy Metals with special reference to Chromium, Cadmium, Lead and Mercury
3.	BRT-03	Identification and quantification of colour causing components in distillery wastewater

TECHNICAL PUBLICATIONS

The regular publications brought out were :

Annual Report (1985-86), Indian Journal of Environmental Health, Volume 28-29, quarterly; Guide to Current Literature in Environmental Health, Engineering and Science, Vol. 17–18, Monthly; NEERI Newsletter, bimonthly; and Technical Digest, bimonthly, on ; (i) No. 72, May 1986 : Arsenic from Suspended Particulate Matter in Air, (ii) No. 73, July 1986 : Cement Concrete Pans and Traps for Low Cost Sanitation Systems, (iii) No. 74, September 1986 : Plant Species for Wastewater Treatment Sites, (iv) No. 75, November 1986 : Spilt Coagulation, (v) No. 76, January 1987: Treatment and Disposal of Paper Mill Effluents, (vi) No. 77, March 1987 : Fish Breeding in Sewage Effluents.



Shri Banwarilal Purohit, M. P. inaugurating the Institute's training course on Environment Management for UP State Official on Sept. 2, 1986

In addition to the regular publications, several special publications were brought out during the year. These were :

(1) NEERI's Contribution to the State of Uttar Pradesh (English & Hindi) (2) NEERI in the Service of Rajasthan (English & Hindi); (3) Orange City Environment (English & Hindi) (4) Sanitation for Rural India, (5) Training Programmes, (6) Project Summary Sheets (Completed Projects) 1985–86, (7) Course Manuals on Waste Water Treatment and Wastewater Analysis, (8) NEERI Information, (9) Seven attractive folders on : (a) Defluoridation of Water by Nalgonda Technique; (b) Disinfection of Rural Water–Chlorine Tablets/ Ampoules, (c) NEERI Pot Chlorinator for Rural Areas. (d) NEERI provides Technology of Slow Sand Filtration for Rural Water Supply, (e) NEERI's Package Water Treatment Plant for Rural Water Supplies, (f) NEERI's Domestic Iron & Manganese Removal Unit for Rural Areas, (g) Water Distribution : NEERI's Contribution.

The Division organised five major events of the Instititute. These were : (i) NEERI Foundation Day on April 8, 1986. (ii) World Environment Day on June 5, 1986 : Shri M. Y. Bedhankar, Editor, The Hitavada, Nagpur was invited the Chief Guest and Dr. P. V. R. Subrahamanyam, Scientist–in–Charge, presided over the function. The highlights were a colourful Poster Exhibition; and Competition on the theme, 'Environment and Peace' and release of four new publications, namely, NEERI Annual Report 1985–86, Sanitation for Rural India, and 'NEERI in the Service of Uttar Pradesh' (in English and Hindi), (iii) Environment Quality Day : This was observed on December 9, 1986. Dr. Mahavir Singh, Station Director, AIR, Nagpur presided over the function, At a Seminar on this day, Dr. Ved Prakash Mishra of Govt. Medical College, Nagpur; Dr. S. D. Badrinath, Scientist, NEERI; and Adv. C. D. Oommachen, MLA and Chairman, Maharashtra Pollution Control Board, Bombay participated, (iv) IJEH Editorial Board Meeting : The First Meeting of the Editorial Board of the Institute's quarterly IJEH (now in its 29th year of publication) was held at the Institute on August 23, 1986. Shri K. R. Bulusu, Acting Director, and Ex–officio, Chairman of the IJEH Editorial Board, presided over the meeting. Members of Editorial Board who were present on the occasion were : Shri S. P. Ambasta, Editor–in–Chief, PID, CSIR, New Delhi; Dr. U. C. Mishra, Head, Air Monitoring Section, BARC, Bombay; Dr. K N. Munshi, Professor of Chemistry, Nagpur University; Dr. W. M. Deshpande of VRCE, Nagpur and NEERI – Dr. P. V. R. Subrahmanyam, Deputy Director, Shri R. Paramasivam, Scientist and Shri C. M. Freitas, Member–Secretary, NEERI; (v) Heads of Divisions Meeting : The Annual Meeting of NEERI's Heads of Divisions at Headquarters and Zonal Laboratories was held on August 24, 1986, to review the R & D activities of the Institute. Shri K. R. Bulusu, Acting Director, presided over the deliberations, (vi) National Science Day : The day was observed by the Institute on February 27, 1987. Dr. N. L. Bhale, Director, Central Institute for Cotton Research, Nagpur, was the Chief Guest and Shri K. R. Bulusu, Deputy Director, presided over the deliberations. A lively Inter–Collegiate debate competition was held on the occasion.

The Division participated in the National Exhibition on 'Water Technology' at Delhi on August 1, 1986.

Other important activities include : (i) Publicity by means of over 30 press releases to Press Information Bureau, Nagpur, Local and National Dailies, All India Radio, Doordarshan, Scientific and Technical Journals in India and CSIR News, New Delhi;

(ii) Compilation and distribution of Information about Seminars, Symposia, Conferences in India and abroad; (iii) Preparation of charts, flow sheets, posters, models, cover page layouts of publications and silk screen printing of certificates for trainees of BRT Division, (iv) Coordination with Bureau of Indian Standards (erstwhile Indian Standards Institution), Central and State Pollution Control Boards, Department of Environment & Forests and NEERI Zonal Laboratories; and (v) Execution of miscellaneous printing jobs.

COMPUTER APPLICATIONS

The year was notable for the introduction of powerful new computational hardware in the Division, which resulted in a quantum leap in computer capabilities of the Institute. The Institute has today a very advanced Computer Programming Environment with the commissioning of the 16/32 bit super-micro CMC Impact 8640 installed in April 1986 and an Hewlett Packard 9050 32-bit Graphics Work station in November 1986.

CAD oversaw the installation, testing, and integration of these systems. It also continued operation management of the existing 8-bit micro-computer and its application software, and its upgradation to a 16-bit CPU/multi-user OS, thereby averting an obsolescence problem and retaining its peripherals utility.

Various application software were developed for scientific and administrative purposes. The main project, 'Computerised Data Handling System for Manpower and Project Planning' was completed successfully with the installation of a Management Information system, comprising On-line Personnel Information Retrieval and Manpower Deployment Reports. Two large software packages received earlier from US EPA were ported to the Impact Computer. One of these is a compendium of state-of-art Applied Air Quality Simulation Models, which are used for research as well as for regulatory purposes.

The project under study is :

Sr. No.	Project No.	Title
1.	CAD-02	Development of Bivane

WORKSHOP

The Workshop continued to meet the R & D needs of scientists including mechanical design and fabrication of gadgets, models and field scale units.

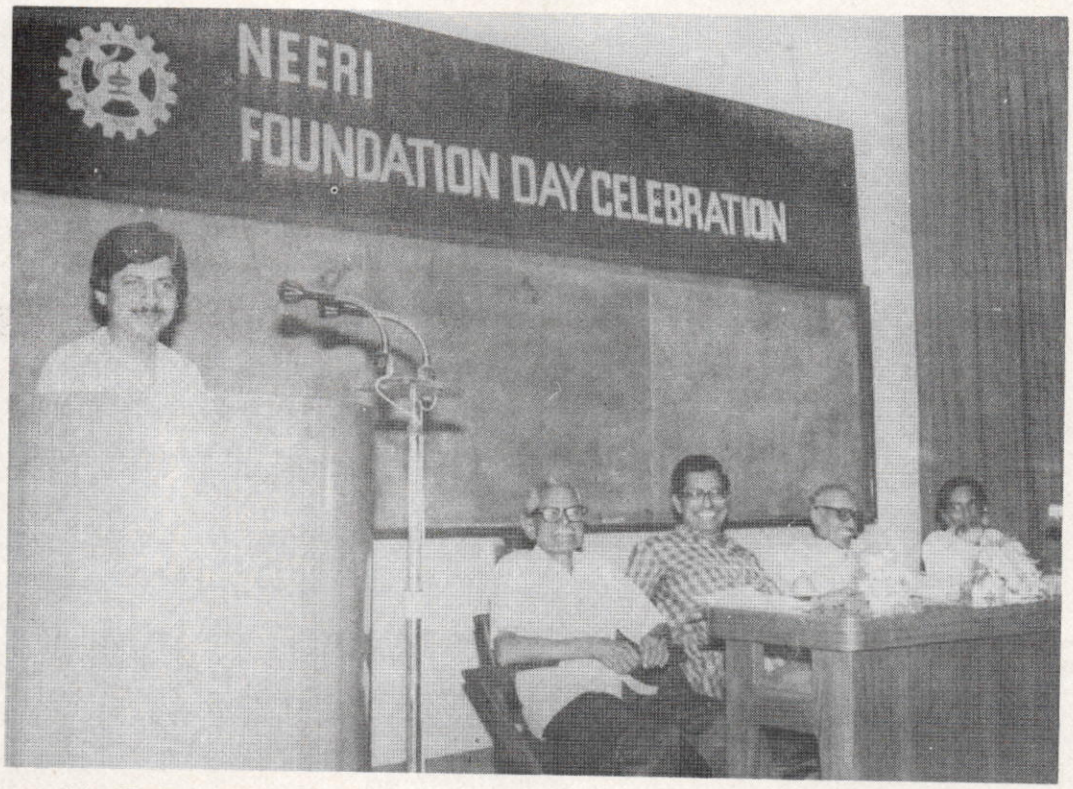
Major fabrication jobs completed during the year were :

(1) Rotating Biological Drum Contactor (anaerobic) - 4 sets

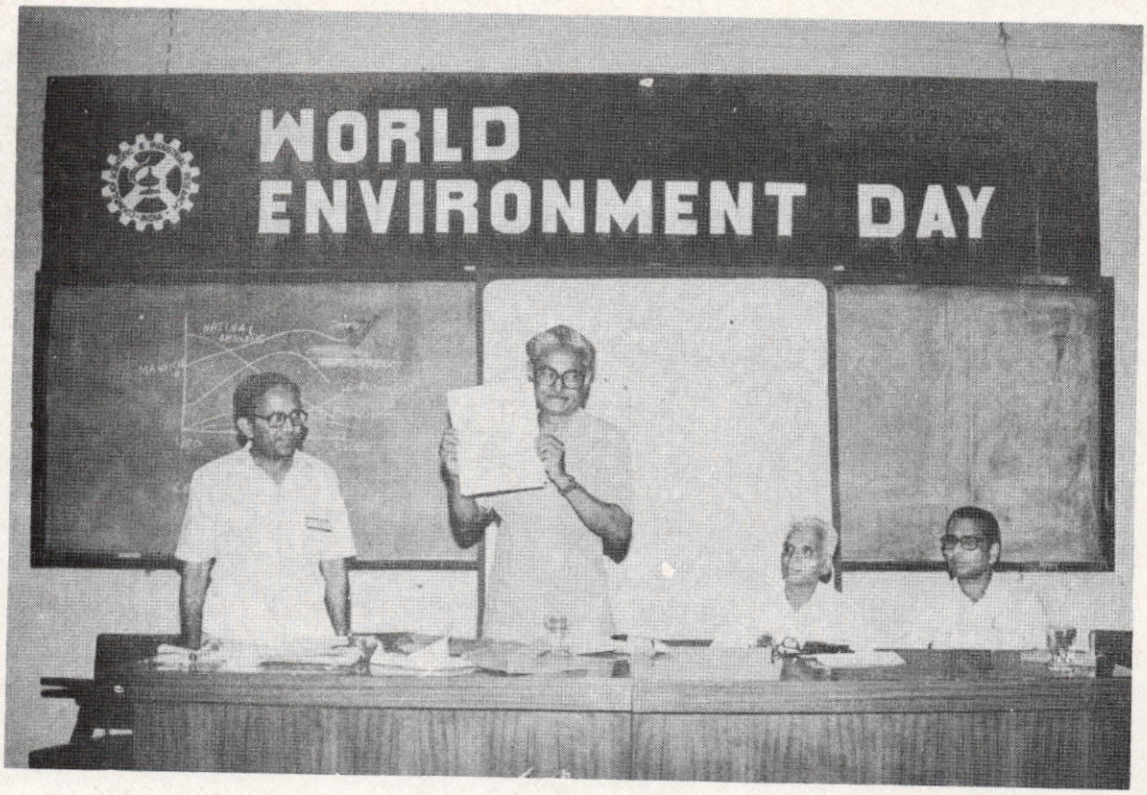
(2) Aluminium Hoppers and its components - 10 sets

(3) Rotating Biological Rope Contactor

(4) High Volume Sampler stands.



Adv. S. G. Aney participating in the Citizens' Debate at NEERI's Foundation Day Celebrations on April 8, 1986



Shri M. Y. Bodhankar, Resident Editor, The Hitavada, releasing the new publications of the Institute on June 5, 1986

Also 174 minor jobs and 249 service jobs were completed.

The Workshop also provides engineering support for water supply and electrical services to the Institute and its residential colonies. The important electrical works completed during the year are :

(1) Installation and commissioning of outdoor distribution boxes.

(2) Laying of underground cables.

Refrigeration and air-conditioning section of the Workshop provides servicing and repairs of equipment, like air conditioning plant, cold room, walk-in incubator and deep freezers.

The upkeep and maintenance of Institute's vehicles, is another vital activity of the Workshop.

PLANNING

The Planning Division has compiled and published the Annual and the Seventh Plan of the Institute. Major activities include : Statistical evaluation of data on R & D projects, Compilation of Research Utilization Data and Project Monitoring and Evaluation. The Division also attends to the information requirements on R&D activities of the Institute.

The Division is also working on the following R&D projects : (i) National Air Quality Network Programme; (ii) Use of Dissolved Air Floatation Technique for Solid-Liquid Separation for treatment, reuse and recycle of industrial wastes; (iii) Improvement in efficiency of unit processes in water treatment, with reference to rapid mixing in flocculation process; & (iv) Toxic metals in environment – their effects, removal and disposal.

LIBRARY & DOCUMENTATION

The following Activities for Organization of Information were carried out :

i) River Ganga-An Overview of Environmental Research :

Based on documentary sources, a review of studies carried out on enviromental aspects of River Ganga has been prepared. Information about on-going research sponsored by LOEn and other related information has been presented. A detailed bibliography of papers and related documents, as well as indexes for easy retrieval have been prepared.

ii) On the occassion of WHO sponsored International Seminar on Diaster Management, organised during October 13-16, 1986 at the Institue, a document titled 'Chemical Diaster Management : Select Information Sources' was brought out.

iii) Specialized bibliographical reviews on (a) Environmental Aspects of Steel Industry, and (b) Environmental Aspects of Dairy Industry were released on April 8, 1986, NEERI Foundation Day.

iv) Indian Literature in Environmental Engineering : A Bibliographical Review, Vol.8, has been compiled and is ready for printing

v) Other Documentation and Information Services which were continued are : (a) Creation of Data Base of Indian Literature in Environmental Engineering : Extensive data have been collected and analysed, (b) Literature Search and Querry Handling, (c) Document Supply Service : Xerox copies of over 83,000 pages were provided, (d) Resource Utilization : 500 persons from various organizations utilised the library resources and 20 Inter-Library Loan Services were rendered, (e) Five students of the Nagpur University's Department of Library and Information Science were imparted training.

The Second Meeting of Council for Advancement of People's Action and Rural Technology (CAPART) at the Institute on Nov. 28, 1986

ZONAL LABORATORIES

1. NEERI Zonal Laboratory
Suburban, Sub–Pumping Station
Beyond Calico Mills,
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: 54081 (Res.)

2. NEERI Zonal Laboratory,
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3. NEERI Zonal Laboratory,
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: 467753 (Res.)

4. NEERI Zonal Laboratory,
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5. NEERI Zonal Laboratory,
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: 5725279 (Res.)

6. NEERI Zonal Laboratory,
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(Andhra Pradesh)
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Phone : 850549 (Off.)
: 853682 (Res.)
Telex : 0425–6162 RRLH IN
(RRL., Hyderabad)

7. NEERI Zonal Laboratory,
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Phone : 74872 (Off.)
: 822730 (Res.)

8. NEERI Zonal Laboratory,
6/33, Civil Lines,
Kanpur–208 002
(Uttar Pradesh)
Gram : NEERI, Kanpur–2.
Phone : 240127 (Off.)
: 218990 (Res.)

9. NEERI Zonal Laboratory,
CSIR Complex,
T. T. T. I.,
Taramani P. O.
Madras–600 113
(Tamil Nadu)
Gram : CONSEARCH, Madras.
Phone : 413964 (Off.)
: 412321 (Res.)
Telex : 041–6876 CSIR IN
(CSIR Compex)

Based upon Survey of India Map with the permission of the Surveyor General of India.

The Territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

ACTIVITIES AT ZONAL LABORATORIES

NEERI ZONAL LABORATORY, AHMEDABAD

Regular monitoring of air quality is being carried out in three different zones of Ahmedabad, *viz.*, residential, commercial and industrial, under the National Air Quality Monitoring Network (NAQMN).

Design of Sewage Disposal System for Gandhidham and Kandla Port Trust Township have been completed.

The projects under study are :

Sr. No.	Project No.	Title
1.	AMA–01	National Air Quality Monitoring Network (NAQMN)
2.	AZL–01	Performance evaluation of Industrial Waste Water Treatment Plant
3.	AZL–02	Reuse of Sewage effluents for general industrial use of Municipal Corporation of Bhavnagar
4.	–	Performance evaluation of Water Treatment Plants in India – Bhavnagar

NEERI ZONAL LABORATORY, BOMBAY

Pollution assessment of Bombay under the National Air Quality Monitoring Network (NAQMN) is a major continuing activity of this Zonal Laboratory.

A study on Environmental Impact of MIDC Industrial Estate, near Bombay and Performance evaluation of Water Treatment plants at Pune, Aurangabad, Kolhapur and Goa, have been initiated.

The Projects under study are :

Sr. No.	Project No.	Title
1.	AMA–01	National Air Quality Monitoring Network
2.	BZL	Performance evaluation of water treatment plants in India : Maharashtra and Goa
3.	BZL	Environmental impact study of MIDC Industrial Estate, near Bombay

NEERI ZONAL LABORATORY, CALCUTTA

Pollution assessment of Calcutta, under the National Air Quality Monitoring Network (NAQMN), is a major activity of this Zonal Laboratory.

Studies on the Environmental Impact Analysis and Assessment of prevailing pollution at Calcutta Port was completed in July 1986.

Survey of Water Quality in the districts of Bankura (West Bengal) and West Khasi Hills (Meghalaya) have been completed under the Technology Mission on Drinking Water in Villages. and Related Water Management Similarly, the work programme for West Khasi Hills is at hand. These districts are reported to be affected by excess of iron in ground water.

Under the Ganga Action Plan of "Prevention of Pollution and Cleaning of the River Ganga," regular monitoring of water samples is being carried out at Patna, Farakka and Calcutta.

The projects under study are :

Sl. No.	Projeet No.	Title
1.	AMA–01	National Air Quality Monitoring Network
2.	WWEI–07	Environmental Impact Analysis and Assessment of prevailing pollution in Calcutta Port Trust area
3.	TUE–02	Technology Mission on Drinking Water and Related Water Management for Villages (Iron removal from ground water)
4.	RIHW–08	Prevention of Pollution and Cleaning of River Ganga
5.	RIHW–05	Toxic Metals in the Environment – their effects, removal and disposal
6.	WE–06	Performance evaluation of water treatment plants
7.	CZL–03	Studies, evaluation and revamping of treatment plant for Rubber Chemical Wastes

NEERI ZONAL LABORATORY, COCHIN

Pollution assessment of Cochin, under the Nation Air Quality Monitoring Network (NAQMN), is a major activity of this Laboratory. Ambient air sampling has been carried out at Q–10 Berth to assess dust emissions before the mechanical unloader of FEDO is commissioned.

In collaboration with Solid Wastes Division at Hqrs, studies were completed on planning for utilization of garbage and other waste materials from Lakshadweep Islands.

Assessment of impact of fertilizer and refinery emissions on vegetation has been initiated at Ambalamughal, Eloor and Palarivattom in collaboration with the Air Pollution Control Division at Headquarters.

Studies have been completed in one out of three pilot zones in Trivandrum City on Preventive Maintenance of Water Distribution System at Trivandrum.

Studies have been initiated on the project Evaluation of Water Treatment Plants by selecting four plants at Mavoor, Peechi, Thiruvalla and Trivadrum belonging to the Kerala Water Authority.

The projects under study are :

Sr. No.	Project No.	Title
1.	AMA–01	National Air Quality Monitoring Network
2.	APC–04	Assessment of spillage and other dust emissions in Q–10 Berth
3.	SW–07	Planning for utilisation of garbage and other waste materials from Lakshadweep
4.	WD–05	Preventive Maintenance of Water Distribution System at Trivandrum
5.	APC–05	Vegetation damage due to fertilizer and refinery emissions
6.	—	Evaluation of Water Treatment Plants in Kerala sponsored by CPHEEO

NEERI ZONAL LABORATORY, DELHI

Pollution assessment of Delhi under the National Air Quality Network (NAQMN) is a major activity of this Zonal Laboratory.

Water Quality of Gurgaon District in Haryana has been completed under the Technology Mission on Drinking Water and Related Water Management in Villages. Regular monitoring of the water quality is also being carried out under the project Prevention of Pollution and Cleaning of River Ganga.

Evaluation of Water Treatment Plants in India and Roughing Filter Pre–Treatment Studies under the International Reference Centre (IRC) Slow Sand Filtration (SSF) Project are being carried out. The Laboratory is collaborating with CLRI, Madras in setting up a demonstration treatment plant for Chrome Tannery Wastes at Agra.

The projects under study are :

Sr. No	Project No.	Title
1.	AMA-01	National Air Quality Monitoring Network
2.	DZL-01	Performance evaluation of water treatment plants in India
3.	—	Technology Mission on Drinking Water and Related Water Management
4.	RIHW-08	Prevention of Pollution and Cleaning of River Ganga

NEERI ZONAL LABORATORY, HYDERABAD

Pollution assessment of Hyderabad, under the National Air Quality Monitoring Network is a major activity of this Zonal Laboratory.

Water Quality Survey in the districts of Kurnool (Andhra Pradesh) and Gulbarga (Karnataka), has been completed under the Technology Mission on Drinking Water and Related Water Management in Villages.

The preliminary report on Performance Evaluation of Water Treatment Plants in Andhra Pradesh, has been completed. Four treatment plants in Kurnool, Rajahmundry, Vishakhapatanam and Warangal, have been surveyed.

Other preliminary studies which have been completed include Assessment of Stack and Fugitive Emission and Impact on Neighbourhood Air Quality at M/s. Ferro-Alloys Corporation Limited; Rheological Behaviour of Sludges; Utilisation of Activated Carbon for Removal of Heavy Metals from Industrial Effluents; and Studies on High Organic Wastewaters using Aerobic and Anaerobic Systems.

The Projects under study are :

Sr. No.	Project No.	Title
1.	AMA-01	National Air Quality Monitoring Network
2.	—	Water Quality Assessment in Kurnool District, Andhra Pradesh & in Gulbarga District, Karnataka
3.	—	Studies on High Organic Wastewaters using Aerobic and Anaerobic Systems
4.	—	Performance Evaluation of Water Treatment Plants in Andhra Pradesh
5.	—	Assessment of Stack & Fugitive Emission and Impact on neighbourhood Air Quality M/s. Ferro-Alloys Corporation Limited.
6.	—	Rheological Behaviour of Sludges
7.	—	Studies on Utilisation of Activated Cabon for Removal of Heavy Metals from Industrial Effluents

NEERI ZONAL LABORATORY, JAIPUR

Pollution assessment of Jaipur and Ghana Bird Sanctury, Bharatpur is being carried out under the National Air Quality Monitoring Network (NAQMN) programme and is a major activity of this Laboratory.

Preliminary studies have been completed on the CPHEEO sponsored project on performance evaluation of Water Treatment Plants in Rajasthan one each at Jodhpur, Kota, Udaipur and Bhilwara, are being evaluated.

Preliminary studies on monitoring of stack emissions from the Hindustan Zinc Ltd Smelter, at Debari, Udaipur and its impact on neighbourhood air quality and land use is in progress.

The projects under study are :

Sr. No.	Project No.	Title
1.	AMA-01	National Air Quality Monitoring Network
2.	—	Performance Evaluation of Water Treatment Plants in India
3.	—	Monitoring of Stack Emissions at Hindustan Zinc Ltd. Smelter, at Debari, Udaipur & its impact on neighbourhood air quality and land use

NEERI ZONAL LABORATORY, KANPUR

Pollution assessement of Kanpur under the National Air Quality Monitoring Network (NAQMN), is a major activity of this Laboratory,

Survey of water quality has been completed under the Technology Mission on Drinking Water in Villages.

In the first phase of the project on Prevention of Pollution and Cleaning of the River Ganga, monitoring of water quality of the river Ganga is being carried at Haridwar, Garh-mukteshwar, Kanpur, Allahabad, Varanasi and Patna.

The projects under study are :

Sr. No.	Project No.	Title
1.	AMA-01	National Air Quality Monitoring Network
2.	-	Technology Mission on Drinking Water and Related Water Management in Villages
3.	RIHW-08	Prevention of Pollution and Cleaning of River Ganga
4.	WE-06	Evaluation of Water Treatment Plants in India

NEERI ZONAL LABORATORY, MADRAS

Water Technology Mission at Ramanathapuram District, Tamil Nadu has been a major activity of this Zonal Laboratory. A representative water quality data report for Ramanathapuram has been made available to the Tamil Nadu Government after undertaking field studies.

The sponsored project on Performance of Water Treatment Plants in India is in progress and six plants at Madras, Coimbatore, Mysore, Belgaum, Bijapur are under study. Interim report has been submitted.

The sponsored project for M/s. Hindustan Photofilms, Ooty, Tamil Nadu has been undertaken. The final report is under preparation. The work involved studying the ambient air quality and gaseous emissions at various stacks.

M/s. Wheels India Ltd., Padi Madras has sponsored a stack monitoring survey. This work has also been completed.

The ambient air quality study, under the National Air Quality Monitoring Network (NAQMN), is in progress for residential, commercial and industrial areas in Madras city.

The sponsored project on BOD evaluation at higher temperatures is in progress.

The projects under study are :

Sr. No.	Project No.	Title
1.	AMA-01	National Air Quality Monitoring Network (NAQMN)
2.	—	Technology Mission on Drinking Water and Related Water Management in Villages.
3.	—	Performance evaluation of Water Treatment Plants in India
4.	—	BOD evaluation at higher temperatures

R & D PROJECTS IN PROGRESS

BRT-01 : Speciation of Sulphur in Sulphurous Waters

A preliminary study of electrochemical properties of the sulphide–polysulphide redox couple has been carried out in samples containing varying concentrations of H_2S, synthetically prepared in oxygen free double distilled water, by measurements of pH, Eh (potential of a platinum electrode) and ES_2 (the potential of a membrane Ag/Ag_2S electrode), the reference electrode being a double junction Ag/AgCl one. This system was studied in an electrochemical cell with and without nitrogen atmosphere being present over the chemical system.

These studies are being extrapolated to systems containing both sulphide and polysulphide species.

BRT-02 : Development and application of physico–chemical speciation schemes for assessment of Environmental Impact of Heavy Metals with special reference to Chromium, Cadmium, Lead and Mercury (DOEn sponsored project)

Standardisation studies with the PARC, 384B model polarograph in combination with static mercury drop assembly, PARC, 303A model have been completed. The basic experimental aspects namely the effect of plating time and increasing pulse amplitude on the stripping peaks of Cu, Cd, Pb and Zn, as well as their mixtures have been studied by Differential Pulse Anodic Stripping Voltammetry. In the determination of these four metals, by optimisation of the basic parameters using DPASV, enhanced sensitivity has been achieved. Studies have also been made to identify the chloro and hydroxy species of the above metals in natural waters.

BRT-03 : Identification and quantification of colour causing components in distillery wastewater

Samples of wastewater from a few distilleries in Maharashtra were collected and characterised. The samples were subjected to adsorption studies on different types of carbons and adsorbates were extracted in suitable solvents and IR spectra was obtained. The IR spectroscopy, COD & TOC estimations indicate that approximately 50% of the colour is due to organic matter. Further verification is in progress.

RIHW-05 : Heavy metals in environment – Their effects, removal and disposal

Studies on precipitation of Cu, Cd, Ni and Pb as hydroxides from solutions containing more than one metal, showed that the precipitation of any one is maximum at the optimum pH of the metal, *viz.*, 7.5 for Cu, 9.0 for Ni and 10.5 for both Cd and Pb. This shows that the presence of the other metal does not have either synergistic or antagonistic effect on the precipitation.

Experiments on precipitation of Cu, Cd, Ni and Pb, as sulphides showed that, from a solution containing 100–150 mg/l of the metal, precipitation as sulphide, leaving the residual metal below permissible limits for discharge, takes place at a sulphide dose 20% less in presence of OH^- than with sulphide alone.

Studies on removal of metals using lignin from black liquor showed that lignin solution (1 gm/l) removes 95% of copper from solution with 20 mg/l as Cu as against only 30% copper removed from the same solution by solid lignin at a dose of 2.5 gm/l.

RIHW-07 : Treatment of wastewaters from organic chemical industries containing high nitrate by anoxic method

A bench scale denitrification column with an empty bed volume of 6 litres was fabricated. The column was packed with pebbles of 2-3 cm dia which resulted in a void space of 3 litres. The required microflora was established in the column by seeding the column with sewage and soil extract and feeding with a mixture of methanol and nitrate. Subsequently, the column was fed with stoichiometric proportion of resorcinol at a loading of 0.3 kg resorcinol/ m^3/d. Resorcinol was selected for the study as it is known to induce a number of enzymes associated with the biodegradation of substituted aromatic compounds.

High nitrate bearing wastewater has been collected from an organic chemical industry manufacturing a number of nitro-aromatics. HPLC analysis of the wastewater showed the presence of meta-nitrobenzene sulphonate, resorcinol, meta-aminophenol, aniline and phenol. Degradation of these compounds, under anoxic condition singly and in combination, in simulated and live wastewater is under study.

WC-03 : Large scale practical application of water desalination with a view to provide safe drinking water to areas affected by salinity problems

NEERI, as one of the coordinating laboratories for the project, is involved in the performance evaluation of eight desalination plants installed in Tamil Nadu, Andhra Pradesh, Gujarat and Rajasthan.

The first and secord phases of performance evaluation studies on desalination plants of Reverse Osmosis (RO) at Lolawas and Electrodialysis (ED) at Misrasia in Rajasthan have been completed.

The second phase of performance evaluation studies of desalination plants in Gujarat and Tamil Nadu have been completed. The reports of first phase evaluation studies of Gujarat and Rajasthan have been submitted to the Adviser, CPHEEO, New Delhi and to the other concerned organisations. The reports of second phase of evaluation studies in Tamil Nadu and Rajasthan have been submitted to the above authorities.

WC-04 : National Project on Defluoridation

(i) Compilation and updating the information on water sources with high fluoride content

(ii) Studies on extension of defluoridation through setting up of pilot plant/ demonstration defluoridation plants and training

National project on Defluoridation : (a) Performance evaluation studies on full scale defluoridation plant (2.27 mld) at Kadiri (A. P.) have been completed and the report submitted to the concerned authorities.

Technolngy Mission on drinking water in villages and related water management

Fifty water samples from 55 problem villages in Jhabua District M. P., were collected for water quality examination with reference to excessive fluoride, nitrate and iron. Another set of 150 water samples for quality examination for above mentioned parameters, were collected from 150 villages in Kurnool District, A. P.

ATD–06 : Development of simplified spectrophotometric procedures for the estimation of Manganese and Zinc in drinking water

Zinc and manganese complexes of 4–(2–pyridylazo) – resorcinol (PAR) were further investigated using Hitachi 330 recording sepectrophotomter to assess the interferences of different cations and anions, normally encountered in potable waters. Further study is in progress.

ATD–07 : Development of field testing ampoules for potable waters

Studies on performance evaluation of the NEERI developed field testing ampoules 'Ferro–ampoule' (for iron) and 'Chrom–ampoule' (for hexavalent chromium) were completed. Stability studies of these ampoules are under investigation. Potable waters of rivers, wells and from the mining areas were studied for estimating iron and hexavalent chromium by these ampoules.

ATD–08 : Studies on mercury in water

Studies on the determination of mercury by graphite furnace atomic absorption spectrophotometry are in progress.

ATD–09 : Development and optimization of liquid chromatographic technique for hazardous trace organic pollutants in drinking water

A high performance liquid chromatographic (HPLC) method has been developed for the determination of trace amounts of 2, 4–D, 2, 4–DB, 2, 4, 5–T, silvex and their methyl esters in water. Mixture of isopropanol and water in gredient elution system, and 60% acetonitrile in water were used as elution systems for resolving the compounds using C18 micro Bondapack column. Partitioning of the water sample mixed with acetone by using a mixture of (1 : 1) dichloromethane and hexane gave a recovery of 40–50% for 2, 4–D, 2, 4–DB, 2, 4, 5–T and silvex and 72–74% for their methyl ester derivatives at concentration ranges of 0.1 – 1.0 μg/l. Detection limits were in the range of 0.5 to 1.0 μg/l for chlorophenoxy acids and 0.3 to 0.9 μg/l for their methyl ester derivatives.

ATD–10 : Optimization of GC–MS technique for the detection of N–Nitroso compounds in water

Trial runs of N–nitrosodipropylamine (NDPA) and N–Nitrosodibutylamine (NDBA) at nanogram levels have been recorded and conditions have been optimised for most abundant ions. Nitrosodimethylamine (NDMA) N – Nitrosodiethylamine (NDEA), N – Nitrosodipropylamine (NDPA) and N–Nitrosodibutylamine (NDBA), were separated using fused silica capillary column coated with AT1000 at 100-130 C and 1 ml/min of helium flow.

WWE–01 : Anaerobic Suspended Bed Reactor and Anaerobic Biological Drum Contactor (A Comparative Study) for Treatment of High Strength Waste Waters

Fabrication work containing anaerobic sludge blanket and two–stage anaerobic biological drum contactor for the treatment of distillery waste has been completed. After satisfactory runs for water and gas leakages, the sludge blanket reactor is being acclimatised with sewage and distillery waste in various proportions. Presently the reactor system is working at a loading rate of 0.1 kg COD/m^3/d with 90–95% COD reductions.

Tracer studies are being undertaken to determine mixing characteristics and flow regimes for anaerobic biological drum contactor at various detention periods.

WWE–II–02 : Treatment of Dairy Waste by Rotating Biological Drum Contactor and Anaerobic Fixed Film Reactor (A Comparative Study)

This study involves three–reactor systems, *viz*., one–stage stone packed upflow contact filter, two–stage anaerobic synthetic packed upflow contact filter and rotating drum contactor. Studies have been completed at loading rates of 0.08 to 0.40 kg COD/m^3/d at a detention period of 3–10 days with good reduction in terms of COD (up to 90%).

Studies are continuing at detention period of 5.1, 2.0 and 4.0 days for various loading rates for all the three reactor systems. Compared to stone media upflow contact filter, the nylon–pad packed bed reactor seems to offer better surface areas for the micro–organisms to utilise the substrate. This is quite evident from high COD reductions to the tune of 95 to 96%. Although readuction in COD and BOD were encouraging even at high loading rate of 6.0kg COD/m^3/d, the studies were discontinued due to choking of the filter columns.

WWE–II–03 : Integrated Environmental Pollution Control System with Energy Recovery in Hindon Basin

River water quality monitoring was completed at eight stations along the Hindon river for one year. The industries in Hindon Basin were enumerated, classified and grouped under sugar mills, distilleries, milk products, paper and pulp mills, and vegetable oils, etc. Waste water sources of two sugar mills and one distillery were identified, classified and evaluated.

The pilot plant studies using Fixed Film Fixed Bed Reactor in the treatment of distillery spent wash are continuing at various loading rates for the recovery of energy at Ajudhia Distillery, Muradabad. Results so far are encouraging. One litre of spent wash gives about 13–17 litres of biogas with 60–62% methane content.

ACP-04 : (a) Preparation of Statement on Environmental Impact Assessment of Ropar Thermal Power Plant (Stage 2nd and 3rd Expansion).

The authorities of the Punjab State Electricity Board approached NEERI for carrying out detailed Environmental Impact Studies of their existing 2x210 MW unit of Thermal Power Plant at Ropar on the total ecological systems. Further, the future impact of II and III stage expansion programme of RTPS when 4 more units (of 210 MW each) are commissioned will be studied.

During the course of field studies, it was observed that levels of various pollutants like particulate matter, sulphur dioxides and oxides of nitrogen varied considerably within the plant as well as in neighbourhood ambient air. Suspended particulate matter ranged from 65–663 $\mu g/m^3$ in ambient air and 5300–44000 $\mu g/m^3$ in fugitive emission sampling. The values for fly ash emission from boiler I and II were recorded to vary from 0.05 to 0.36 g/Nm^3 to 0.13-0.27 g/Nm^3 respectively. Gaseous pollutants studied included SO_2 and NO_x. The SO_2 values ranged from 6 to 18 $\mu g/m^3$ SO_2, for ambient air and 0.31 g/Nm^3 for boilers. Gaseous pollutants in fugitive emissions were found to be in traces only.

(b) : **Assessment of Stack and Fugitive Emissions from Zinc–Smelter and its impact on Neighbourhood Air Quality and Land Use**

Field studies pertaining to (i) Stack emission characterisation of all the processes (ii) Ambient air quality monitoring (iii) Fugitive emission monitoring from undefined activities within plant premises and (iv) Land use pattern, were carried out at Zinc Smelter at Udaipur.

Since the smelter process involves production of Zinc, Cadmium, Silver, Sulphuric acid, Phosphoric acid and Lead (refining), the emissions from various stacks also varied from unit to unit. Sulphur dioxide concentrations (emission) ranged from 1,970–3,870 mg/Nm^3 and 5,778–25,182 mg/Nm^3 in the old and new sulphuric acid plants and 61,711–1,02,800 mg/Nm^3 and 67,493–11,7,710 mg/Nm^3 in the old and new roasters respectively, whereas in boiler, SO_2 conc. ranged from 2,430–2,604 mg/Nm^3.

Suspended particulate matter values were found to be minimum 18 $\mu g/m^3$ in slag smelter, whereas, the maximum SPM 2,858 $\mu g/m^3$ was recorded in silver recovery plant, while, in other stack, values ranged from 28 to 1780 $\mu g/m^3$. Average oxides of nitrogen were 391 and 399 $\mu g/Nm^3$ in boiler and new roaster.

Ambient air quality (24 hrs average) observations revealed that conc. of SPM, SO_2 and NO_x ranged from 62 to 392 $\mu g/m^3$, 6-247 $\mu g/m^3$ and 4–177 mg/m^3 resspectively. Of the observations made, 95% were within 115–832 $\mu g/m^3$ for SPM and 7–516 $\mu g/m^3$ for SO_2.

The fugitive SO_2 emission was as high as 789 $\mu g/m^3$ whereas the SPM values (FE) ranged from 328–4078 $\mu g/m^3$ and oxides of nitrogen from 3–17 $\mu g/m^3$ and fluoride concentration varied from 6–146 $\mu g/m^3$.

Impact of stack emissions on ambient air quality, soil and neighbourhood land use were also studied. The report is under preparation.

(c) : **Environmental Impact Assessment Study for three Thermal Power Stations of 100 MW, 440 MW and 630 MW Units located in M. P.**

Field studies at Thermal Power Stations of 100, 440 and 640 MW capacity located in M. P. are in progress. This pertains to the Impact of emissions on neighbourhood air quality, land use and vegetation.

(d) : **Assessment of all stack and fugitive emissions, its impact on neighbourhood air quality and evaluation of collection efficiency of control system of Photofilm Manufacturing Process.**

Hindustan Photo Films is located in the sensitive area of Ottacamund (Tamil Nadu) where emissions can be damaging to the ecological system. Studies on the air pollutant

emissions from various units were carried out for formulating air pollution control systems so that ambient air quality is within the permissible limits for such sensitive areas and damage to ecological system is minimum.

Field investigations were carried out to assess the emissions of SPM, SO_2, NO_x CO_2 and CO from various units/processes/stacks and its impact on air quality in nearby areas. Observations revealed that dust concentrations were maximum 4.14 g/Nm³ in smelting furnace No. 2 and minimum 0.03 g/Nm³ in smelting furnace No. 2. Oxides of Sulphur (Total) were 2,610 mg/Nm³ (maximum) in silver nitrate plant (S. N. P.) boiler followed by 1,455 mg/Nm³, in smelting furnace No. 2 and the minimum 247 mg/Nm³ were recorded in calcining furnace No. 3. Similarly, oxides of nitrogen ranged from 50 to 768 mg/Nm³ in main boiler and smelting furnance No. 2. Status of ambient air quality within 5 km radius was monitored and the pollution concentrations varied from 28 to 506 $\mu g/m^3$ for SPM, 3 to 60 $\mu g/m^3$ for SO_2 and 3 to 44 $\mu g/m^3$ for NO_x whereas fugitive emissions from various sources for SPM, SO_2 and NO_x were observed to be in the range of 43 to 445 $\mu g/m^3$, 3 to 627 $\mu g/m^3$ and 3 to 3632 $\mu g/m^3$ respectively. The maximum NO_x emission was near the refinery plant (Station 2) and minimum in down wind direction at Station No, 4.

(e) Assessment of Spillage and other dust emissions from ship unloader being installed for FACT in Q-10 berth at Wellington Islands, Cochin

Spillage valuations during ship unloading operation is being carried out to determine material dropping during bucket movement between hatch of ship and unloader hopper; and material loss which becomes air borne when the material falls during the above movement of bucket.

APC-05 : Ecophysiological responses of regional plant species to Refinery and Fertilizer emissions-sponsored by DOEn, New Delhi

Field studies are in progress. Four sampling sites have been selected in the vicinity of refinery and fertillizer complex at Cochin. Mango, Coconut, Jack Fruit and Cashewnut have been identified for biomonitoring of pollutants in the region. Pollution sensitive parameters are Chlorophyll-a, Chlorophyll-b, Carotenoids, Enzymes, Sugars and Proteins, Sulphate and Fluoride. For ambient air quality SO_2, SPM, NO_x and Hydrocarbons are being monitored. For seasonal bio-monitoring of pollution load, group of plants are also exposed at each site in addition to the perennial plants mentioned above.

AMA-01 : National Air Quality Monitoring Network

SPM samples collected from Bombay, Calcutta, Madras and Delhi are being analysed for cation/anions and water soluble fractions of sulphate and nitrates. In addition, poly-aromatic hydrocarbons are also being analysed on GCMS system. The Sulphate and Nitrates are the major parameters for acid rain potentiality measurements, whereas aromatic hydro-carbons highlights the status of carcinogenic agents and their respective sources for developing control strategies.

In addition toxic heavy metals, viz., Pb, Ni, Cu, Cr, Cd, Zn, etc. are also being analysed. After these analyses, the major sources of air pollutants shall be identified and then detailed emission inventory studies of urban centers shall be undertaken. This activity has been extended up to December 1987.

APC–06 : Development and testing of high efficiency scrubbing system for combustion boilers for simultaneous absorption of NO_x and SO_x,

Two NEERI scientists alongwith IOC Coordinator have visited Haldia and Mathura refineries for an onsight evaluation.

WE–02 : Improvement in efficiency of Unit Processes in Water Treatment with reference to rapid mixing in Flocculation Process.

Based on factorial design, batch type experiments have been conducted using two litre volume of samples to optimize rapid mix velocity gradient and time in the process of flocculation for raw water turbidity of 480 NTU. Particle size analysis has been conducted for raw water suspension having 30 NTU turbidity and rapid mixed at various velocity gradients for 40 seconds duration. Data compilation and interpretation are in progress.

WE–03 : Bench scale studies on recovary of alum by Liquid Ion Exchange (LIE) Technique.

Work on continuous experiments on extraction and stripping using synthetic aluminium solution is being continued. Studies on : Effect of Tri–n–butyl phosphate; Effect of mixing in baffled containers; Experiments on effect of other metals during extraction and concentration of heavy metals in sludge have been carried out. The salient findings are given below :

- Addition of tri–n–butyl phosphate as modifier had helped in phase separation without affecting the extraction efficiency;
- Providing baffles in extraction chamber has no appreciable effect on mixing efficiency in extraction. However, marginal difference was observed in stripping;
- Di–2 EHPA, the extractant used has selectivity over other metals at different pH values. Metals like Ca,. Mg, Fe, Mn and Zn which are likely to get extracted at pH 2.0, along with Al, have been tried using synthetic solution. Ca, Mg, Mn and Zn are not extracted. Iron got extracted to the extent of 34%.
- Sludge samples in rainy and fair seasons have been acidified and supernatant analysed for metal contents like Ca, Mg, Fe, and Mn.
- Extractant recycling :– Comparable efficiency was obtained to get 85–90% transfer up to 10 cycles.

The optimum conditions arrived at using synthetic alum solution are being applied to the actual water treatment plant waste.

WE–04 : Field testing of a package water treatment plant

The fabrication of the package plant has been completed. Modification of outlet arrangements and plate settler of the package water treatment plant has been done. The settler module was re-installed and the plant was tested for leaks. Arrangements are being finalised with M/s. Richardson & Cruddas (1972) Limited, Madras for field testing of the unit at Madras.

WE-05 : Slow Sand Filtration (SSF) – Phase IV

Design and drawings for construction of experimental horizotal flow roughing filters for pre-treatment studies have been finalised. Pre-filtration studies on the pilot plant installed at Chandrawal Water Works No. II, Delhi are in progress.

A draft Hindi version of the course manual for slow sand filter caretakers has been prepared and is under finalisation for review.

WE-06 : Performance Evaluation of Water Treament Plants in India

A critical evaluation of the performance of representative water treatment plants of different capacities selected from various regions of the country has been undertaken, in order to bring out a critical analysis of the state-of-the-art of O&M of plants, focus attention of implementing agencies on the deficiencies, if any, in current practices and to suggest possible remedial measures thereof. The study includes collection of engineering data and information from design officers, and discussions with senior engineers and plant personnel as well as field visits.

Fifty one representative water treatment plants have been selected from different regions of the country. Detailed proformance have been designed to collect design and engineering data for the water treatment plants to be studied. Visits to some of the plants have been made for evaluation.

WE-07 : Performancc Evaluation of Water Distribution System of seven selected cities in India

Field preparations in three cities, and identification of project sites for the proposed study, are in progress.

WE-08 : Development and Testing of Direct Reading Electric Network Analyser for the Analysis of Existing Water Distribution System.

Ramtek, a small town near Nagpur, has been identified for constructing a simulation model of the water distribution system. Capability building exercise for building such model has already been sucessfully completed by the research team. Field data from the water supply system is being collected.

LS-01 : Impact of normal plankton in the aquatic environment for removal of pollutants such as nitrates, phosphates, chlorinated hydrocarbons, organophosphorus pesticides and heavy metals.

48-h LC50 of cadmium, copper and silver to Copepod (*Cyclops* sp.), Cladocera (*Alona* sp.) Ostracod (*Cypris* sp.) were determined. Silver was found highly toxic to all the three zoo-plankton. Among the organisms, *Cypris* was most susceptible to the toxicants and *Alona* was resistant to Cadmium and Silver. Copper, which is often used as algicide, is non-toxic to *Cyclops*. At higher concentrations (10 mg/l and above) *Cyclops* were alive and copper got precipitated.

Laboratory technique for culturing ciliated protozoa *Tetrahymena pyriformis* has been established. The impact of cadmium to the protozoa with reference to cell number/ml and

morphological changes have been studied. The protozoa were exposed to eight concentrations, namely, 0.04, 0.05, 0.07, 0.10, 0.15, 0.20, 0.25 and 0.30 mg/l Cd with 3 to 6 replicates each. Appropriate control was maintained. The lethal concentration (LC100) was determined as 0.3 mg/l.

EES-03 : Biological monitoring of water pollution.

Phase I : Ciliated protozoa and algal colonization on artificial substrates for assessing aquatic environment.

Periphyton samples were collected from oligotrophic and eutrophic environment and analysed for species composition, relative distribution, biomass and chlorophyll content. These parameters showed significant changes corresponding to changes in water quality. Higher values of biomass chlorophyll and per cent dominance in periphyton were recorded in eutrophic waters and lower values were recorded in oligotrophic waters. Physico-chemical parameters of water quality were studied regularly in the ecosystems under study.

Phase II : Effect of pesticides on algae.

Algal bioassays were carried out to study the toxicity of BHC and Aldrin and the effect of environmental factors on the pesticide-algae interaction. Environmental factors like dissolved nitrogen, phosphorus and organic matter were found to decide the nature of pesticide-algae interaction. Morphological changes in the cell structure of *Scenedesmus, Chlorella* and *Spirulina* were studied at algistatic and algicidal concentrations of the pesticides – this milestone aspect has been completed during this period.

LS-03 : Control of mosquitoes by some aquatic plants.

(a) Water samples where *Lemna* plants were growing well were analysed for pH, DO, Orthophosphates, NO_3-N, Total hardness, BOD_5 and potassiun to assess the tolerance of various pollutional levels by *Lemna* plants. It was observed that the plants could grow in sewage effluents and other polluted water.

(b) Larval emergence studies conducted in the laboratory show that *Lemna* plants can successfully control the mosquito breeding. In addition, dip samples have been taken from stagnant waters in the campus area to regularly monitor the mosquito breeding in presence of growth of *Lemna* plants. It was observed that plants were capable of controlling the mosquito breeding.

(c) Feeding experiments with fish in laboratory have shown that some fish species feed on *Lemna* plants.

LS-04 : Virus removal and survival through sludges in various waste water (pilot-plant) systems.

Methodology for the recovery of enteric viruses from domestic sewage sludge has been finalised. Three different methods were tried for this purpose.

S. No.	Method	Comparative recoveries of virus PFU
1.	Sonication (Glass) method	14–25
2.	Beef extract elution (Berg) method	40–50
3.	Freon method	100

Using the Freon method, with chilling of the samples, raw sludge yielded a virus count as high as 4 lakh PFU/litre; which reflects the magnitude of the hazard from sludges.

Study of sludge from the rotating biological disc has been initiated. Pilot sludge drying beds are being fabricated to assess the effect of drying of sludge on the load of virus.

LS–05 : Impact of land application of wastewater on autochthonus soil microflora and their interaction with the organisms introduced through wastewater.

With view to develop the new methodology and concept and get acquainted with advance knowledge in relation with the present research work exhaustive literature survey has been carried out in the first phase of work. Pot experiments have been carried out with the application of raw sewage, raw sewage diluted in 1:1 proportion, settled sewage stabilization pond effluent and fish pond effluent to the soil. The microbial flora and the chemical constitutent of the wastewater were monitored before every application to the soil. The variation in soil microflora as well as chemical transformation of the constituent present in the wastewater after application was evaluated. Four sets of observations were made and it was found that there were changes in soil microflora and some of the chemical constitutents got transformed to the stable forms ($NH_3 \rightarrow NO_3$).

LS–06 : Evaluation studies of air-borne microorganisms to assess air quality in cities (Madars & Nagpur).

The project was commenced from April '86. Initial work on microbial quality and quantity was started for different groups of microorganisms present in air. Use of nutrient agar, crystal violet agar, sodium azide and bile salt agar was tried for their use in differentiation of different groups of organisms. Slit air sampler were used for air sampling and period required for necessary sampling at air flow rate of 126 l/min has been worked out. Field units for measurement of quantity of air analysed have been fabricated and standardized. Work on air sampling at different places at Madras has been started.

LS-07 : Resource recovery from pulp and paper mill solid wastes through bioconversion process.

Cellulosic waste (solid) samples were collected from a small paper mill and analysed for chemical parameters. It was observed that it contains 3–4 percent moisture, 65 to 70 per cent organics, 30 to 35 per cent inorganics, 2 to 2.5 per cent lignin and 1–2 per cent nitrogen (Kjeldhal) on dry weight basis. Amongst the organic contents, cellulose was a major portion (90–95 per cent). To get the biomass rich in protein, cellulotic microorganisms such as

Trichoderma Myrothecium, Sporotrichum and *Fusarium* are being tested for their ability to utilize cellulose from cellulosic waste as carbon and energy source. For anaerobic digestion, two digesters of 10 litre and 5 litre capacity were set-up and are being fed daily with cow-dung slurry in order to establish anaerobic conditions.

LS-08 : Microbial degradation of wastewater from coal carbonization & gasification industries in treatment plants.

Preliminary visit to one of the treatment plants has been made and contacts were established.

EM-04 : Use of bituminous coal for concentrating enteric viruses from water and wastewater

In the earlier studies, it was observed that poliovirus gets adsorbed at pH 5 when $AlCl_3$ was added. In order to determine the adsorption capacity of bituminous coal, experiments were conducted using different concentrations of virus keeping the same concentrations of coal (0.2 gm) in 100 ml of dechlorinated tap water. It was kept on rotary shaker (200 rpm) for 10 min. Clear supernatant was collected and assayed for viruses. It was observed that virus concentration as high as 5.68×10^5 could be adsorbed on 0.2 gm of coal indicating its high virus adsorption efficiency.

EM-08 : Microbial degradation of pesticides

Studies on influence of nutrients, on microbial degradation of malathion present in synthetic wastes were continued in continously fed completely mixed aerated system, operated, at 24 hrs hydraulic detention time, using methanol, ethanol, maleic anhydride (likely to be present in wastewater) and acetate (100 mg/l each) as nutrients at neutral pH.

It was found that methanol and ethanol enhance the COD reduction to the extent of 62 to 64%, acetate 60 to 61% and maleic anhydride 52 to 53%. The effluents were found to be non-toxic when subjected to bioassay studies.

Inst-05 : Comparative evaluation of different Instrumental Methods for detection and measurement of heavy metals in the environment.

Studies on Cu and Cd has been taken up.

TD-01 : Use of dissolved air flotation technology for solid-liquid separation in the treatment, reuse and recycle of industrial waste

Studied are in progress

TD-02 : Evaluation of an Improved rotating biological rope contactor (RBRC) technology for wastewater treatment

Bench-scale model has been fabricated and studies are being conducted for the treatment of wastewaters. While working with domestic sewage (BOD 150 mg/l) at an organic loading of $16g/m^2/day$, a reduction of 90% is achieved with a detention time of 1.3 hours. A similar efficiency is obtained using milk waste (COD, 1500/l) with a detention period of 6 hours.

The unit combines adventages of (i) Being completely indigenous (ii) low cost (iii) higher treatment efficiency than the Rotating disc, because of more surface area available within the same tank volume (iv) potential for universal application in aerobic treatment of biodegradable wastes.

Based on the laboratory studies, a Pilot Plant has been fabricated and installed in the NEERI campus. Detailed studies are to be carried out on this low cost system for wastewater treatment.

TD-03 : Determination of 'K_i' the inhibition coefficient in activated sludge

Heavy metals, pesticides and other inorganic chemicals like cyanides impart toxic effects and influence the biological wastewater treatment processes. The measurement of inhibition factor 'K_i' in bacterial system aims at the assessment of inhibitory toxic effects on the biological treatment systems. The inhibition effects of a particular toxicant can be estimated in about three hours time.

Non-inhibited D. O. depletion patterns with Activated sludge are being assessed. D. O. depletion pattern with Hexavalent Chromium are also being found out. The data is being used for standardization of inhibition pattern and K_i factor for Cr^{+6}.

COMPLETED PROJECTS

NEERI-CSIR Coordinated Project on Mines to Metals & Habttat

NEERI has completed studies in May, 1986 on the provision of safe drinking water at the Chromite Mines at Kaliapani, Orissa which has a problem of excess of Hexavalent Chromium in water.

The project was entrusted to NEERI by the CSIR Coordination Council (Engineering Group) during 1985-86. The Orissa Mining Corporation (OMC), Bhubaneshwar coordinated with CSIR Laboratories involved in this project. The formulation and implementation of integrated development plan will be done jointly by Engineering Group of Laboratories of CSIR and OMC.

The primary aim of the Coordinated Project is to study the total environment at the Chromite mine at Kaliapani, Orissa with a view to study the feasibility of providing latest CSIR technologies for mining, mineral processing, roads and buildings. The environmental problems are likely to increase over the years because the OMC has plans to extend Chromite mining activity. The output of the ores is to be raised annually by 0.5 million tonnes. The main sample of drinking water is from the abandoned quarries, Dhamsala Nullah and dug wells in the colony.

NEERI's participation was confined to the study of : (i) Provision of safe drinking water to mines, colony and adjoining areas; and (ii) Evaluation of feasibility of utilising water colleoted in the abandoned mines.

NEERI carried out the water quality assessment studies at all these sources. The samples were analysed for physicochemical parameters and heavy metal levels.

The analysis indicates that Hexavalent Chromium is present in most of these water sources in varying concentrations. Water from Dhamsala Nullah, the major source of water for the colony contains 0.06 mg/l of Hexavalent Chromium and needs to be treated for removing Hexavalent Chromium.

The mine waters are characterised by low pH, low total solids and low conductivity.The concentration af Hexavalent Chromium is between 0.01 mg/l and 0.012 mg/l. Treatment of the water can be achieved by adding 40 mg/l $FeSO_4$, 20 mg/l lime and 60 mg/l alum dose.

Design of water treatmeut plant incorporating such a treatment is described in this report. The design has been based on treatability studies carried out at the mine site. The treatment proposal incorporates; suitable design criteria treatment specifications and flow sheet of the treatment process.

— **Treatment and Disposal of Wastewater from Chrome Leather Company, Madras**

Studies on the treatment and disposal of wastewaters from M/s. Chrome Leather Company, Madras have been completed.

The factory was designed to process 1860 m of hides per day. In terms of weight, the production amounts to one tonne of finished leather per day. Prior to the study, the production was around 15-20 tonnes per month.

The factory authorities requested NEERI to undertake an inplant survey, characterisation of wastewaters and to suggest a suitable treatment system for wastewaters from the factory.

The treatment system suggested by NEERI consists of physico-chemical methods followed by biological treatment in an aerated lagoon. Treatment flow sheets with semi-detailed engineering drawings of proposed treatment units alongwith cost estimates have been provided to the company.

— **Design of Sewage Disposal System for Gandhidham and Kandla Port Trust Townships**

The Institute has recently provided the design for sewage treatment plants for Gandhidham, Adipur and Kandla in Gujarat State.

The sewage treatment plants have been designed for the population in the year 1991. No industrial waste component has been considered for the design and only domestic sewage will be admitted to treatment units. Treatment units have to be added for 2001 AD to 2011 AD population depending on the quality and characteristics of sewage generated.

For the plants at Gandhidham and Adipur, treatment by stablisation ponds is proposed in view of the availability of land. However, in case of Kandla, two alternatives have been proposed, aerated lagoon and lagoon type aeration tank working on extended aeration principle. The report contains salient features of the schemes including layout plans semi-detailed engineering drawings, hydraulic profiles, specifications and land requirements.

- Remodelling of Sewage Treatment System, Hyderabad

The Institute has recently completed studies on field investigations, characterisation, laboratory studies and submitted detailed schemes for the treatment of sewage for the twin cities of Hyderabad-Secundrabad for the flow expected by the year 1991.

The Municipal Corporation of Hyderabad has planned to construct two new sewage treatment works on either side of the river Musi to cater to the needs of the twin cities for the year 1991.

Two separate sewage treatment systems, one for the area North of the river Musi at Nagole of 113.5 mld and the other on the river's South at Uppal of 340 mld. At Uppal, activated sludge systems with provision of sludge digesters and sludge drying beds has been recommended and is the most suitable. For Nagole site, two treatment alternatives have been proposed - conventional activated sludge and extended aeration. Two reports, Volume I : Remodelling of the existing Sewage Treatment Plant at Amberpet; and Vol. II : Agricultural Utilisation of Treated Sewage, have been submitted.

CAD 1 : Development of computerized data-handling system for manpower & project-planning in Environmental Research.

The computerized system developed under this project will be of immense help in effective R & D management and can be implemented with minimum change in configuration of Hardware & Software. This system not being large or elaborate further enhances its portability. By using a relational DBMS approach, the entire system has been kept very simple. Thus, adding on more relations (such as other attributes of scientists – e. g. papers published specialized training, etc.) has been simplified. Programmes (command files) have been written in a structured and modular way, enabling adding more modules at will. This exercise has also resulted in design and testing of data relations which will facilitate extensions of the system to larger relational DBMS application software. The same basic file and data stuctures have already been used for a larger, multiuser, DBMS, which is an outgrowth of this project.

– Technology Mission on Drinking Water in Villages and Related Water Management

The Institute has recently completed the survey of water quality in nearly 400 Indian villages under the First Phase on the Technology Misson on Drinking Water in Villages and Related Water Management in five districts in the States of Andhra Pradesh, Haryana, Karnataka, Madhya Pradesh and Tamil Nadu.

The Districts are Kurnool (AP), Jhabua (MP), Gulbarga (Karnataka), Ramanathapuram (TN) and Gurgaon (Haryana).

The Technology Mission has been launched by the Government of India to supplement the efforts of State Governments in the Accelerated Rural Water Programme (ARWSP) which aims at providing safe drinking water to the entire rural population. The primary objective of the Technology Mission is to improve the performance and cost effectiveness of the ongoing rural water supply programmes so as to ensure on a sustained long-term basis the availability of adequate quantity of drinking water of acceptable quality.

The Mission envisages an integrated and inter-disciplinary approach to deal with specific water quality problems such as salinity, iron, fluoride, bacteriological contamination as also scientific water management consistent with ecological stability through afforestation and soil conservation. This will be achieved through pilot projects by the application of all available scientific and technological inputs from various CSIR laboratories and other R & D institutions in coordinated manner.

The Council of Scientific & Industrial Research (CSIR), New Delhi has been identified as the Nodal Agency for all S & T inputs by its constituent laboratories.

Kurnool district (AP) has been identified as Fluoride, Salinity/Brackishness, Guinea Worm and Water Scarcity problem district. The District has rural population of 19.29 lakhs. Out of 150 villages which were surveyed, 80 where excess fluoride problem villages.

Gulbarga district (Karnataka) has an area of 16,224 sq. km. and a poqulation of 20.8 lakhs spread over its 10 talukas. The survey covered 105 villages. The major water quality problems of the district are brackishness/salinity and presence of excess fluorides.

Jhabua district in MP has an area of 6800 sq. km. and a population of 7.95 lakhs. A major problem of the district is drought. Out of the 55 villages surveyed by NEERI, 13 villages had a problem of excessive fluoride in water. Ten villages had excessive nitrate. Guinea worm was another common problem in many villages.

Ramanathapuram district in Tamil Nadu has an area of 4,207 sq. km. population of 11.32 lakhs and 423 villages. Survey of 66 villages showed that brackishness and salinity are major water quality problems. Five villages had a problem of excess iron and seven villages had excess of nitrates.

– Solid Waste Management

The Institute has completed a major study for the Central Ganga Authority for improving the environment of Varanasi City in Uttar Pradesh. The expertise acquired by the Institute in the field of Solid Waste Management was utilised. It has recommended that the present refuse disposal methods should be changed and Sanitary Land Filling Method should be adopted.

Improper disposal of solid waste can often result in pollution of water sources. As such a situation existed at Varanasi, the Central Ganga Directorate desired NEERI to look into the problem posed by the existing system of refuse improvement on short-term as well as long-term basis.

The Institute initiated a study and necessary information and samples were collected. The existing quantities were accurately measured and the collected refuse samples analysed for physical and chemical characteristics.

A critical evaluation of the existing method of collection, transportation and disposal was made and an interim report identifying areas where immediate improvement is required was submitted in May, 1986. The Final Report was submitted in August, 1986. Some of the major recommedations are :

1. Presently, the collection work is controlled by three different wings of the Varanasi Municipal Corporation. This results in lack of coordination and it is necessary to have a unitary control over the system.
2. Additional sites for collection of refuse were identified.
3. To replace old vehicles, additional vehicles need to be purchased. The types and number of such vehicles were indicated.
4. It was recommended that vehicles should be housed in a garage. A site was selected and detailed layout plan given.
5. The maintenance of vehicles should be improved for which provision of necessary facilities and staff were recommended.
6. The present disposal methods should be changed and sanitary land-filling should be carried out by following specific methods at six identified sites.
7. The total cost that will be incurred for implementing these recommendations was also specified.

— **Utilisation of Solid Wastes from Lakshdweep Islands**

On a request from Lakshdweep Administration, the possibilities regarding various solid wastes such as coconut pith, fish waste and municipal solid waste was studied. Detailed studies were conducted on samples of waste material like fish waste and coconut husks. Based on the analysis of samples and the data collected, recommendations were made for the utilisation of different kinds of waste.

The municipal solid waste is produced at the rate of 0.109 kg/capita/day and is commonly composted in pits.

The coconut pith tends to accumulate at the processing site and the quantity at the production centre is estimated to 120 tonnes per year. It has got a good water retaining capacity and can be used as good soil conditioner. It can be pyrolysed to get char, fuel gas and oil.

Fish waste is produced while processing the fish. It can be used for the productino of fish meal after addition of trash fish. Alternatively, it can be used as a fish manure for coconut trees.

The report giving detailed recommendations has been submitted to the Lakshadweep administration.

WWE-II-01 : Studies on Contact Stabilization using Industrial Wastewaters.

The following wastewaters were tried for their treatability in contact-stabilisation process.

i) Dairy waste (synthetic)

ii) Starch waste (synthetic)

iii) Carboxymethyl cellulose waste (synthetic)

i) Dairy Wastewaters (Synthetic)

Wastewater loading rates tried ranged between 0.02 to 2.0 kg BOD/kg, MLSS/d at various detention periods, *viz.*, 0.5 to 2 hr for contact unit and 1 to 10 hr for stabilisation unit. The influent BOD was adjusted to range between 200–2000 mg/l with COD/BOD rate of 1.6. At low BOD concentration i. e. up to 300 mg/l, the removal efficiency was between 70–80%. However, at BOD concentration above 500 mg/l, the efficiency of removal was above 80%. Nitrogen and phosphorus removal ranged between 85–90%. This indicated that there is not enough colloidal matter for adsorption in contact unit at 301 mg/l BOD. System was operated at various biomass concentration in contact and stabilisation units. Biomass concentration ranged between 1000–4000 mg/l and 5000-12000 mg/l respectively.

Optimum loading rate was observed to be 0.85 to 1.03 kg BOD/kg MLSS/d with BOD removals in the range of 80–85%. The optimum detention periods for both the units were found to be 1.2 and 4.2 hr. with MLSS concentration 3500 mg/l and 9800 mg/l respectively. At this loading rate, SVI was always in the range of 85–100. If the detention period in the contact unit was reduced below 1.2 hr, the wash out of biomass occured. Biomass concentration above 3500 mg/l and 9800 mg/l in contact and stabilisation units resulted in bulking of

the sludge in the sedimentation tank. It was found that 1.8 hr of detention period in sedimentation tank is sufficient for proper settling of the sludge. Application of loading rates above 1.2 kg BOD/kg/MLSS/d always resulted in bulking of the sludge with SVI index greater than 200. The specific resistance and calorific values of the sludge at a loading rate of 0.085–1.03 kg BOD/kg/MLSS/d were found to be 6–7x10 s/g and 3881–4435 K. cal/kg.

ii) Starch Wastewater (Synthetic)

Synthetic waste with BOD/COD ratio between 0.4–0.5 and supplemented with nitrogen and phosphorus was used. Nitrogen and phosphorus were added in various proportions to determine the optimum dose with respect to BOD. It was found that the optimum dose should be BOD:N:P = 50:7.5:1. to avoid sludge bulking in the sedimentation tank. Phosphorus and nitrogen removals were in the range of 90-93%. The various loadings in the range of 0.01 to 1.5 kg COD/kg MLSS/d were tried. Various combinations of biomass concentration in contact and range of 60–70% and 50–65% respectively. However, no sludge bulking was found during the course of this study. The specific resistance and calorific values at a loading rate of 0.4 kg COD/kg MLSS/d were found to be 5.5–6.7x10 s/g and 3715–4269 K. cal/kg.

(iii) Carboxy methyl cellulose (Synthetic)

Similar studies were carried for synthetically made carboxy methly cellulose wastewater with N and P supplement BOD:N:P ratio was kept in the range of 100:5:1. Overall loadings, were varied from 0.01 to 0.25 kg COD/kg MLSS/day with influent COD varying from 200 to 1500 mg/l. The treatment efficiency was not good. COD removal generally varied from 33 to 65% which is far from desirable. Biomass concentrarion in both the unit was varied from 3000–5000 mg/l and 6000–12000 mg/l respectively. The sludge did not settle well with SVI index always greater than 220. Minimum detention periods for both the units should be at least 2 and 6 hr. respectively. It appears that this system of treatment with CMC waste is not good.

In all the above wastes that were tried, the minimum air to be applied was found to be 500 M air/overall 0.5 kg. BOD load. The recirculation rates for sludge were in the range of 25-125. It was also observed that the total capacity of the reactor can be reduced to one half in comparison to conventional activated sludge process excepting for treatment of carboxymethyl cellulose wastewater. This concept can help in remodelling of existing treatment plants to take double the organic loads provided wastewaters are colloidal in nature. However, this process is susceptible to shock loads in terms of hydraulic and organic conditions. It can not withstand changes in stabilisation unit were tried viz. 1000–6000 and 4000–12000 mg/l respectively. Concentration of COD above 1000 mg/l was found to be minimum for satisfactory operation of this system. The overall loading rate of 0.30 kg COD/kg MLSS/d was found to be the optimum with detention periods of at least 1 hr and 3 hr in contact and stabilisation units. COD removal efficiency was in the range of 80-85%. MLSS in both contact and stabilisation units should be around 4500 and 1000 mg/l. At higher concentration of biomass in both the reactors, difficulties were encountered in settlement of sludge. The specific resistance and calorific value at a loading rate of around 0.30 kg COD/kg MLSS/d were found to be 8.5-9.0 x 10 s/g and 4546–5045K.cal/kg respectively. At this loading rate, SVI was found to be in the range of 80-120, The minimum detention period in the sedimentation tank was found to be 2.0 hr.

(iii) Municipal Sewage

Overall loading rates were varied from 0.02 to 0.5 kg COD/kg MLSS/d with detention periods from 0.5–2 and 1 to 6 hr. in contact and stabilisation units respectively. Biomass concen-

tration in both the units ranged between 2500-4500 and 5000-12000 mg/l respectively. The optimum overall loading rate was found to be 0.4 kg COD/kg MLSS/d with detention period of 0.75 and 3.00 hr in contact and stabilisation unit. The sludge settled properly with SVI ranging from 75 to 90. Minimum detention period in the sedimentation tank was determined to be 1.7 hr. BOD/COD reductions were in the range of 95-98% and 87-90% respectively. Application of loading rates greater than 0.4 kg COD/kg MLSS/d resulted in decreased BOD/COD removals in the detention periods of more than 25% for over a period of more than 3 hours. Changes in concentratation of COD more than 30% over a period of eight hours result in reduction of COD efficiency and improper settlement of sludge in the sedimentation tank.

- **Treatment of Wastewater from the proposed Monochrotophos pesticide plant of M/s. National Insecticides and Chemicals Limited, Chandigarh**

M/s. National Insecticides and Chemicals Limited (NICL), Chandigarh manufactures 900 kg/day of monochrotophos based on the know-how supplied by Regional Research Laboratory, Hyderabad.

The wastewater quantity discharged from various production processes would be around 6.37 m^3/day. The wastewater is slightly acidic and has high BOD and COD values.

Construction of solar evaporation ponds was suggested, as it provides a simple method of evaporation of pesticide wastewaters with a low operational cost and is a hygienic disposal method.

The report presents the data on characteristics of wastewater, treatment unit sizes, specifications and semi-detailed engineering drawings. Appropriate cost estimates and land requirements have also been suggested.

APPENDIX-I

RESEARCH ADVISORY COUNCIL

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Chairman,
Coordination Council of Engineering
Groups of CSIR Laboratories

Prof. P. Khanna
Director, NEERI, Nagpur

Tenth meeting of the Research Advisory Council was held on August 22, 1986.

APPENDIX-II

EXECUTIVE COMMITTEE

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Coordination Council of
Engineering Group of
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Member–Secretary

Dr. V. R. Bhave
Scientist & Head,
Instrumentation Division
NEERI,
Nagpur–440 020

The 35th and 36th Executive Committee Meetings were held on April 17, 1986 and December 18, 1986 respectively.

APPENDIX-III

FINANCE SUB-COMMITTEE

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Shri V. Vaardarajan
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Mount Road Extension,
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Members

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Chief Manager (Finance & Accounts)
Mineral Exploration Corp. Ltd.,
Seminary Hills,
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Shri L. R. Tijare
Dy. Controller of Accounts
National Savings Organisation,
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Ex–officio Member
Chief (Finance)
Council of Scientific & Industrial Research,
New Delhi–110 001

Convenor
Finance & Accounts Officer
NEERI,
Nagpur-440 020

The Ninth Finance Sub–Commitee meeting was held on October 15, 1986.

APPENDIX-IV

SPECIAL REPORTS

Sr. No.	Title	Sponsor
1.	Treatment & disposal of wastewaters from the fertilizer factory	M/s. Fertilizer Corporation of India, Talcher
2.	Studies on causes of corrosion and frequent breakdowns of sewers in Ahmedabad city	Ahmedabad Municipal Corporation, Ahmedabad.
3.	Validity of BOD determination at higher temperature	Central Pollution Control Board, New Delhi
4.	Remodelling of Sewage Treatment System, Hyderabad-Volume III	M/s. Fertilizer Corporation of India Hyderabad.
5.	Design of sewage disposal system for Gandhidham & Kandla Port Trust Townships	M/s. Kandla Port Trust, Gandhidham
6.	Treatment and disposal of wastewaters from Chrome Leather Company, Madras	M/s. Chrome Leather Company Ltd., Chromepet, Madras.
7.	Utilization of garbage and other waste materials of Lakshadweep	Institute project
8.	Development of computerized data handling system for manpower & project planing in Environmental Research.	Institute project
9.	Technology Mission on Drinking Water in Villages & Related Water Management.	CSIR, New Delhi

APPENDIX-V

NEERI SEMINAR GROUP

Chairman
Prof. P. Khanna
Director
from January, 1987
Shri K. R. Bulusu
up to December, 1986

Convener
Shri A. D. Bhide,
Scientist & Head,
Solid Wastes Division

(Mrs.) M. V. Vaidya, Scientist, Water Division was awarded the first prize of Rs. 100/- for her Seminar on "Iron Removal from Ground Water by Gravity Filters" delivered on 11-9-1985.

The following Seminars were delivered by NEERI Scientists and Invitees during 1986-87.

Sr. No.	Speaker	Topic	Date
1.	Mr. V. R. Paranjpe, CMC, Bombay	Highlights of Impact Computer System	8-5-1986
2.	Mr. Un Jaining Republic of China	Municipal Refuse Treatment	13-6-1986
3.	Shri A. M. Deshkar	Validity of BOD Determination at higher temperatures	2-7-1986
4.	Shri S. R. Kshirsagar	Rural Sanitation	4-8-1986
5.	Dr. W. Durr, FRG	Analytical Quality Control	8-10-1986
6.	Shri P. Mukherjee Minister for Environment, Govt. of West Bengal, Calcutta	Environmental Problems in West Bengal	22-10-1986
7.	Dr. H. S. Rao Managing Director, NRDC, New Delhi	Role of NRDC in transfer of Technology and its various aspects	20-11-1986

Sr. No.	Speaker	Topic	Date
8.	Shri A. R. Rao	Centre for Peoples Action and Rural Technology	28-11-1986
9.	Shri Anil Agarwal	Ecology	11-12-1986
10.	Dr. (Mrs.) R. Sarkar	Biological Monitoring of Water Quality	12-12-1986
11.	Dr. G. H. Pandya	Quality Assurance for Air Pollution Measurement System	30-1-1987
12.	Dr. B. Klapwijk, The Netherlands	Removal of Nitrates from Ground Water	4-2-1987
13.	Mr. N. Gebremedhin, UNEP, Nairobi.	UNEP's activities and possible collaboration with NEERI	23-2-1987
14.	Dr. (Mrs.) A. S. Gadkari	Environmental awareness and necessary pre-requisities for environmental protection	13-3-1987

APPENDIX – VI

PAPERS PUBLISHED PRESENTED IN SEMINARS/SYMPOSIA/CONFERENCES

Name of Author (s)	Title of the paper	Published in/presented at
1.	2.	3.
1. Aggarwal. A. L.	Technology Alternative for Air Pollution Control in Small/Medium Scale Industries like Foundaries, Lime Kilns and Furnace Boilers	Presented at National Workshop on Building Meterial Technology at Delhi, March, 11–12, 1987
2. Badrinath, S. D. Deshpande, V. P. Kaul, S. N. & Gadkari, S. K.	Design Aspect of Settling Tanks (Basin)	IWWA, Vol. XVIII No. 2, April–June 1986
3. Badrinath, S. D. Gadkari, S. K. & Kaul, S. N.	Role of Environmental Impact Analysis in Project Planning	Industrial Safety Chronicle Oct.–Dec. 1986
4. Badrinath, S. D. Kaul, S. N. & Gadkari, S. K.	Training Needs for Environmental Planning	National Seminar on Training Needs for Internationally Aided Projects organised by Country & Town Planners, New Delhi–Ministry of Urban Development, India, Jan. 1987.
5. Bhat, S. G.	Chemical Disaster Management : 'Selected Information Sources'	Presented at WHO Sponsored Workshop on Disaster Management, held at NEERI, Nagpur Oct. 6–10, 1986
6. Bhide, A. D. Shekdar, A. V. Olaniya, M. S. & Gaikwad, S A.	Evaluation Studies on some Indian Mechanical Compost Plants	Presented at the Workshop on Solid Waste Management, CPHEEO, New Delhi, Jan. 16-17 1987
7. Bhide, A. D.	Utilization of Solid Waste from Lakshadweep Islands	Presented at Futurology Work shop for Lakshadweep Islands at RRL, Trivandrum in July 1986

Name of Author (s)	Title of the paper	Published in/presented at
8. Bulusu, K. R.	Defluoridation for Small Communities by the Nalgonda Technique	Presented at the International Workshop–cum–Conference on Fluoride & Dental Health, Madras, Jan. 5–8, 1987
9. Bulusu, K. R. & Nawlakhe, W. G.	Defluoridation of Water by by Activated Alumina	– do –
10. Chakrabarti, T.	Environmental Protection Acts–An Overview	Scavenger, 17, 21–28 Jan. 1987
11. Chaudhari, P. R. Jayangoudar, (Mrs.) Indira & Krishnamoorthi, K. P.	Response of some common fresh water algae to DDT applications (1986)	Proceedings of International Conference on Pesticides : Toxicity, Safety & Risk Assessment, October 1985
12. Chaudhari, P. R. Jayangouder, (Mrs.) Indira & Krishnamoorthi, K. P,	Influence of environmental water quality parameters on the Phytotoxicity of DDT	Proceedings of the INSA, Part B, 52, No. 4, 499–504 (1986).
13. Chaware, Y. D. Dhabadgaonkar, S. M. Khan, A. N.	Performance Evaluation and Kinetics of Rotating Biological Contactors for waste water treatment	Annual Conference of IAWPC at Nagpur on Octomber 18–19, 1986
14. Das, S. K., Ghosh, A. & Raman, V.	Environmental impact and treatability of liquid effluents from a Titanium dioxide pigment plant	Indian Journal of Environmental Health, Vol. 29, 16–25, 1987
15. Deshmukh, S. B. & Deshpande, C. V.	Alkali-lignin removal by Uncoventional Methods	Indian Journal of Environmental Health, Vol. 28 (4), 342–344 (1986)
16. Deshpande, A. W. Bassin, J. K. Ratnaparki, S. N. & Bhave, V. R.	Direct Reading Electric Analogue for the Hydraulic Analysis of Pipeline Network	Institution of Public Health Engineers (India), XIII Annual Convention on Env. Engg. Jan. 9–11, 1987.
17. Deshpande, C. V. Satyanarayan, S. (Mrs.) Deshkar, A. N. Wate, S. R. & Srinivasan, M. V.	Effect of Low Solids concentration on Anaerobic Digestion of Night Soil	Indian Journal of Environmental Health, Vol. 28 (4), 273–278, (1986)

Name of Author (s)	Title of the paper	Published in/presented at
18. Deshpande, V. P. Gadkari, S. K. Badrinath, S. D. Kaul, S. N.	Review of a New Concept in Water Treatment Pebble Bed Flocculator	Journal of Indian Water Works Association, Vol. XVIII, 4, 295, Oct. 1986
19. Deshpande, V. P. Badrinath, S. D. Raman, V. Mariappan, M. & Manivelu, V.	Characteristics & Treatment of Wastewater from factory manufacturing Di-Calcium Phosphate	Presented at Annual Paper Meeting of Institution of Engineers (India) at Mysore, April 1986
20. Dhage, (Mrs.) S. S. Paramasivam, R. Andey, S. P. & Ravindra, Rao, R.	Effect of Thermal Power Plant Pollution on Water Treatment	National Seminar on Pollution Control & Disaster Planning at Birla College, Kalyan, Jan. 1987
21. Dharmadhakari, D. M. Hasan, M. Z., & Bhave, V. R.	Comparative studies on Mercury determination	Indian Journal of Environmental Health, Vol. 29, 72-74, 1987
22. Gadkari, S. K. Badrinath, S. D. Deshpande, V. P. & Kaul, S. N.	Problems on Process Waste Treatment Technologies in India- A Case Study	Indian Journal of Environmental Protection, Jan. 1986
23. Gadkari, S. K. Chakradhar. B. Kale, S. N. & Badrinath, S. D.	Biological Denitrification using Fluidized Bed Reactor System	Asian Environment, Vol. 5 (1) 1986
24. Gadkari, S. K. Aboo, A. B., Badrinath, S. D. Mothanaraman, V. & Kaul, S. N.	Treatment of Wastewater from Small Scale Natural Rubber Processing Units	Annual Conference of IAWPC at NEERI, Nagpur on Oct. 18-19, 1986
25. Gadkari, S. K. Kaul, S. N. Deshpande, V. P. & Badrinath, S. D.	Pollution Control Strategies for Tapioca Starch Industry in India	J. IPHE (I) No. 2, 1-9, April-June, 1986
26. Ghosh, T. K. & Krishnamoorthi, K. P.	Aberrant specimen of Cat fish, *Clarias batrachus* from sewage stabilisation pond	Indian Journal of Environmental Health, 28 (3) : 247-249, 1986
27. Ghosh, T. K. & Krishnamoorthi, K. P.	Effects of sewage on gonad development and fat accumulation in fishes	Environment & Ecology, 4 (2), 191-196, 1986

Name of Author (s)	Title of the paper	Published in/presented at
28. Hasan, M. Z. Pande, S. P. & Saxena, K. L.	Heavy metals in aquatic environment	Journal of the Water Works Association XVIII (2) 155–159, 1986
29. Hasan, M. Z. Pande, S. P. & Saxena, K. L.	Estimation of Cyanide and their removal by biological methods	Indian Science Congress, 74th Session, Bangalore Jan. 3–8, 1987
30. Hasan, M. Z. Pande, S. P. & Saxena, K. L.	Separation and Precaution Techniques in Water Quality Monitoring	Indian Science Congress, 74th Session, Bangalore Jan. 3–8, 1987
31. Juwarkar, A. S. & Shende, G. B.	Interacion of Cadmium, Lead : Effect on growth, yield and content of Cd and Pb in Barely (*Hirdeum Vulgare*)	Indian Journal of Environmental Health, 28(5), 235–243, 1986
32. Juwarkar, A. S. & Shende, G. B.	Behaviour of Cadmium in Calcaneous Soil : Transformation, Growth, Response and Uptake by plants	International Symposium on Environmental Pollution & Toxicology, at Hong, Kong, Aug. 1986
33. Juwarkar, A. S. & Subrahmanyam, P. V. R.	Impact of pulp and paper mill wastewater on soil and crop	Water Sci. Tech., 19, 693, 1987
34. Kaul, S. N. Gadkari, S. K. Badrinath, S. D. & Deshpande, V. P.	Biogas from Industrial wastewater	J. Inst. of Public Hlth. Enginers, No. 3 Vol. 1986, pp. 5–17, 1986.
35. Kaul, S. N. Badrinath, S. D. & Swarnakar, N. G.	Power Consumption, Formulation of Pitch Bladed Surface Aerator	J. Inst. of Public Hlth. Engineers (India), June 1986.
36. Kaul, S. N. & Sundaresan, B. B.	Turbulence : A Significant Parameter for design of Activated Sludge System	J. Inst. Public Hlth. Engineers (India), June 1986.
37. Kaul, S. N. Shivraman, N. Kumaran, P. Pandey, R. A. Swarnakar, N. G. Parhad, N. M. & Raman, V.	Activated sludge pilot plant plant for the treatment of Phenolic Wastewaters	J. Chem. Engg. World, XXI, 81, Oct. 1986.

Name of Author (s)	Title of the paper	Published in/presented at
38. Khan, A. N.	Biological Approach to the Rotating Disc Wastewater Treatment Process	J. of Industrial Pollusion Control, Vol. 2, No. 69–79, Dec. 1986.
39. Kondawar, V. K. Bhave, V. R. Thakkar, (Mrs.) N. & Muthal, P. L.	Ion Chromatography : Principles and applications in environmental analysis	Indian J. of Environmental Health, Vol. 28, No. 4, 324 (1986)
40. Krishnamoorthi, K. P. & Sarkar, (Mrs.) Rekha	Ecosystem approach of Biological monitoring of Water Pollution	Presented at the Indo–US Joint Workshop on Biomonitoring and Bio-conservation in receiving waters by the Central Ganga Authority at Jawaharlal Nehru University, New Delhi, Nov. 10–14, 1986.
41. Kshirsagar, S. R.	(i) Housing and Environmental Health	WHO Workshop on Environmental Health and Housing in Rural and Urban Development Policies, at Madras, Sept, 23–26, 1986.
	(ii) Selection of appropriate technology for water pollution control	All India Convention on Water and Air Pollution at Bombay, Nov. 19–22, 1986.
	(iii) Air Pollution Survey of Chembur, Trombay Area	Sixth All–India Congress on Respiratory diseases at Bombay, Dec. 11–14, 1986.
	(iv) Basic concepts and parts of effluent treatment plant	Workshop on Industrial effluents monitoring of quality & Pollution Control at Bombay, Dec. 29–31, 1986.
	(v) Control of Pollution in Small Towns and Rural Areas	National Seminar on Pollution, its control & disaster planning at Birla College, Kalyan, Sept. 1986.
42. Kulkarni, P. B. Bhole, A. G. & Bal, A. S.	Colour removal by Granular Activated Carbon	Annual Conference of IAWPC, at NEERI, Nagpur, Oct. 18–19, 1986.

Name of Author (s)	Title of the paper	Published in/presented at
43. Kumaran, P.	Development in Biotechnology on toxic waste treatment	Proceedings of Symposium on Environmental Biology & Coastal Ecosystem, Academy of Environmental Biology (India), 1986.
44. Mhaisalkar, V. A. Paramasivam, R. & Bhole, A. G.	An Innovative Technique for Determining Velocity Gradient in Coagulation Flocculation Process	Water Research, Vol. 20, No. 10, pp. 1307–1314, (1986).
45. Mishra, R. P.	Waste Water Recycling for Pollution Control	Proceedings of National Seminar on 'Air and Water Polltion' at University College of Engineering, Burla (Orissa), on April 14, 1986.
46. Mudri, S. S. Venkat Rao D. Rama Rao, K. G. Rama Prasad, R. V. Ravishankar, V. Pampattiwar, V. L. Aggarwal, A. L. & Murty, Y. S.	Ambient Air Quality at Visakhapatnam - A Case Study	Indian Journal of Environmental Health, Vol. 28 No. 4, 284–295, (1986).
47. Nandy, T., Pathe, P. P., Kaul, S. N., Badrinath, S. D., Swarnakar, N, G., & Gadkari, S. K.	Oxygenation capacity of Mechnical Aerators for Water Treatment	Journal of Indian Water Works Association, April 1986.
48. Nanoti, M. V., & Nawlakhe, W. G., & Kulkarni, D. N.	Non–Conventional Technologies for Rural Drinking Water	Industrial Engineering Journal, Vol. XV, No. 9, 10–18, Sept. 1986.
49. Nanoti, M. V., Bulusu, K. R., & Rao, C. S. G.	Water Resources & Quality of Lakshadweep	'Futurology Workshop to identify the Science & Technology Input for Lakshadweep' at Regional Research Laboratory, Trivandrum, July 21–23, 1986.
50. Nanoti, M. V. & Nawlakhe, W. G.	Operational experiences on water with Special Reference to the Defluoridation Plant at Kadiri	Presented at the International Workshop-cum-Conference on Fluoride & Dental Health, Madras, Jan.5–8, 1987.

Name of Author (s)	Title of the paper	Published in/presented at
51. Nashikkar (Mrs.) V. J., Chakrabarti, T., & Shende, G. B.	Effect of Cd and Cr in Sludge amended soils on the Enzymatic Activities and Growth of Maize and Pea.	International Symposium on Environmental Pollution and Toxicology at Hong Kong, 1986
52. Nashikkar, (Mrs.) V. J., Wachasunder, S. D., & Chakrabarti, T.	Effect of Chromium and Cadmium on plant growth and yield of pea (*Pisum sativum*) and nitrification process in sludge amended soil	Annual Conference of Indian Association for Water Pollution Control, at NEERI, Nagpur, Oct. 18–19, 1986
53. Nath, K. J. Badrinath, S. D. & Kaul, S. N.	On-site water treatment facilities for Water Supply Schemes	International Conference on Water Supply and Mid-term Decade sponsored by IPHE & & Loughborough University, UK, Jan. 7, 1986
54. Nawlakhe, W. G. Nanoti, M. V. & Bulusu, K. R.	Defluoridation of Water	Presented at the Indian Water Congress, New Delhi, March 11–13, 1987.
55. Nawlakhe, W. G. Kulkari, D. N. & Lutade, S. L.	Iron and Manganese Removal	–do–
56. Nema, P., Shivastava, S. K., Deshkar, A. M., Kankal, N. C., Gokhe, B. H., & Mehta, C. G.	Pilot plants studies on anoxic lagoon (Series) System for sewage at Ahmedabad	Indian Journal of Enuironment Health, No. 4, 196-302, Vol 28, 1986
57. Nema, P., Shrivastava, S. K., kankal, N. C., Mehta, C. G. & Gokhe, B. H.	Rural Water Supply Schemes in Gujarat–Maintenance & Management	J. Institution of Engineers (India), 1986.
58. Pande, S. P., Hasan, M. Z., & Saxena, K. L.	Nitrate and Nitrites Environment : An Overview	Journal of Indian Wates Works Association, XVIII (2), 201–208 (1986)

Name of Author (s)	Title of the paper	Published in/presented at
59. Pande, S. P.	A field testing ampoule (chromampoule) for soluble hexavalent chromium determination in drinking waters.	Indian Science Congress, Bangalore, Jan. 3–8. 1987
60. Pandey, R. A., & Kumaran, P.	A modified method for thiocyanate estimation	Indian Journal of Environmental Health, Vol. 28, 96–104, 1986.
61. Paramasivam, R., Jan Teum Visscher & Santacruz, M.	IRC's Slow Sand Filtration	Waterlines Journal Vol 4, No. 3, January 1986
62. Paramasivam, R.,	Unaccounted for Water in the Distribution System	Proc. of National Seminar on 'Water & Sewerage Tariff', Ministry of Urban Development Govt. of India, New Delhi, Sept. 9–11, 1986
63. Rao, D. S., Reddy, R. C., Murahari, Rao Rama Rao, K. G., Vitthal Rao, M., & Gajghate, D. G.	Wastewater treatment & disposal of BHC plant effluents – A case study	IAWPC Annual Conference at NEERI, Nagpur. Oct. 18–19, 1986
64. Reddy, M. K.	Assessment of particle size from selected industrial emission sources	Indian Journal of Environmental Health, Vol. 29, 39-44, 1987
65. Sarin, R.	(i) New Directions to future water quality legislations on speciation of heavy metals.	National Seminar on Air & Water Pollution held at Univ. College of Engg., Burla, April 12–14, 1986.
66. Sarin, R.	(ii) Recent Advances in Environmental Monitoring Analytical Technlques.	National Seminar on Environmental Pollution Control & Monitoring, CSIO, Oct. 21–23, 1986.
67. Sarin, R.	Electroanalytical techniques for the measurement of trace/toxic pollutant in aquatic environment.	National Seminar on Physico-chemical methods, Environment, Molecular structure, Tirupati, Nov. 24–26, 1986.

Name of Author (s)	Title of the paper	Published in/presented at
68. Sarin, R.	National Water Quality Monitoring Programme – Some areas recognised being deficient	National Workshop on Water Quality Monitoring held at Central Board for Prevention & Control of Water Pollution, New Delhi, Dec. 15-17, 1986.
69. Sarkar, (Mrs) Rekha, Krishnamoorthi, K. P. Chaudhari, P. R., & Rao, A. V. J.	Ecological responses of fresh water periphyton community for water quaity evaluation	IAWPC Annual Convention, at NEERI Oct. 18-19, 1986.
70. Satyanarayan, (Mrs) S., Kaul, S. N. Badrinath, S. D., & Gadkari, S. K.	Biogas from Anaerobic Digestion of Human wastes	National Conference on Consortium of Rural Technology at Aug. 12, 1986.
71. Satyanarayan, (Mrs) S., Wate, S. R., Deshpande, C. V., & Srinivasan, M. V.	Effects on Nitrogen Supplementation of Biogas Production from Cattle Dung	Asian Environment, Vol. 8 (2), 1986.
72. Saxena, K. L., Kaul, S. N.. Hasan, M. Z., Gadkari, S. K., & Badrinath, S. D.	Packed bed anaerobic reactor for treatment of meat wastes	Asian Environment, Vol. 8 (2), 20-24, 1986.
73. Saxena, K. L., Hasan, K. L., Pande, S. P.	Nitrogenous pollutants and alkalinity in aquatic environment	Indian Science Congress, 74th Senssion, Bangalore, Jan. 3-8 1986.
74. Seth, A. K.	Monitoring of Air Pollutants and approach in evolving well defined monitoring network	Proceedings of National Seminar on Effects & Remedies of Pollution in General and Impact of Small Scale Industry on Development & Environment (1986).
75. Sharma, H. C.	Response of Wheat plants to Hydrogen fluoride fumigation	International Workshop-cum-Conference on Fluoride & Dental Health, at Madras, Jan. 5-8, 1987.
76. Shekdar, A. V., Bhide, A. D., & Krishnaswamy, K. N.	Inventory Theoretic Approach to Dustbin Capacity	Asian Environment, 8, (1), 6-9, 1986.

Name of Author (s)	Title of the paper	Published in/presented at
77. Shekdar, A. V. Bhide, A. D., & Tikekar, V. G.	Optimization of routes of refuse transportation vehicles	Indian J. of Environmental Health Vol. 29, 1–15, 1967.
78. Shende, G. B.	Agronomical aspects of Wastewater irrigation	Regional Workshop on Treatment and Reuse of Sewage Effluent for irrigation, organize by FAO at Amman, Jordan, August 10–13, 1986.
79. Shivaraman, N., & Parhad, N.M.	Biodegradation of phenol and cyanide by pure and mixed cultures.	Indian Journal of Microbiology, 25, 79, 1985.
80. Swaminathan, (Mrs) K., Kondawar, V. K. Chakrabarti, T., & Subrahmanyam, P. V. R.	Identification and Quantification of Organics in Nitro Aromatic Wastewaters.	Indian Journal of Environmental Health, Vol. 29, 32-32, 1987
81. Swaminathan, R., & Subrahmanyam, P. V. R.	Treatment and disposal of phenolic wastes	Workshop on Water Pollution Control held at PCRI, BHEL Hardwar, July 18–19, 1986.
82. Tapan Routh., & Dhaneshwar, R. S.	Anaerobic Treatment of Distillery Spent–wash	Indian Journal of Environmental Health Vol. 28, No. 2 1986.
83. Thakre, (Mrs.), R. A.	Impact of Indian Lime Kiln Emissions on Flora : A case study.	National Workshop on Building Material Technology, Delhi, March 11-12, 1987.
84. Thakre, (Mrs.), R. A., & Krishna, (Mrs.) Meera	Women and Industrial Environment Management	National Seminar on Role of Women in Agro – Industrial Perspective for Environmental Reconstruction, at ICAR, New Delhi, Dec. 9–10, 1986.
85. Thakkar, (Mrs.) N. & Pande, S. P.	Study of Organo–Chloro–pesticides in some urban water sources.	J. of Indian Water Works Assn. XVIII (4),315–316, 1986.
86. Thakkar, (Mrs.) N.	Pesticides pollution levels in urban water resources.	IAWPC Annual Conference at Nagpur, Oct. 18–19, 1986.
87. Thakkar, (Mrs.) N. & Saxena, K. L.	Performance evaluation of ACC and GAA to remove, prp' DDT, pip' –DDE and p. p' – DDT'	Indian Science Congress, 74 th Session, Bangalore, January 3–8, 1987.

Name of Author (s)	Title of the paper	Published in/presented at
88. Wase, R. C.	A Study on Fringe benefits with special reference to personnel of NEERI, Nagpur	Nagpur University, Nagpur, April 1986.
89. Wate, S. R., Chakrabarti, T., & Subrahmanyam, P. V. R.	Effect of boron on biogas production from Acetate, Cow dung	Indian Journal of Environmental Health, 28 (3), 203, 1986.
90. Wate, S. R. Ramteke, D. S. Moghe, C. A.	Anaerobic treatment of distillery wastewater – A phase separation concept	All India Seminar on Water Quality Ground Urban, Eco-system & their Management, Chhindwara, Dec. 27-29, 1986.
91. Wate, S. R.	Hydrogen production in anaerobic digestion – A possibility	National Symposium on Environmental Biotechnology, Nanded, Dec. 28-30, 1986.
92. Wate, S. R, Chakrabarti, T. & Subramanyam, P. V. R.	Biogas augmentation by Trace Elements	11 th Conference on Energy from Biomass and Waste at Orlando, Floride, March 16-20, 1987.

APPENDIX VII

MEMBERSHIP OF BUREAU OF INDIAN STANDARDS COMMITTEES

Sr. No.	Name of the Committee, Committee Number	Name of the Representative Principal Member (P) Alternate Member (A)
1.	Concrete pipes Sub-Committee BDC 2:6	A. W. Deshpande (P) B. V. Kale (A)
2.	Sanitary appliances and water fittings Sectional-Committee BDC 3	A. W. Deshpande (P) R. C. Dlxit (A)
3.	Domestic and municipal water fittings Sub-Committee BDSC 3:2	A. W. Deshpande (P) R. C. Dixit (A)
4.	Water meters Sub-Committee BDC 3:4	N. G. Swarnakar (P) R. C. Reddy (A)
4.	a) Panel for safety in handling and use of asbestos BDC 2:3/P.2	M. V. Nanoti (P) D. M. Dharmadhikari (A)
5.	Water Works fittings Sub-Committee BDC 3:5	A. K. Seth (P) S. M. Tamhane (A)
6.	Plastic pipes Sub-Committee BDC 3:8	R. Paramasivam (P) (Mrs.) S. S. Dhage (A)
7.	Panel for Water supply and plumbing BDC 13:P 4	V. A. Mhaisalkar (P) P. Nema (A)
8.	Fluid flow in closed circuits BDC 17:3	A. W. Deshpande (P) S. N. Dhone (A)
9.	Dilution methods Sub-Committee BDC 17:7	D. Reguraman (P) R. K. Pandi((A)
10.	Water supply & sanitation Seetional-Committee BDC 24	A. Raman (P) P. V. R. C. Panicker (A)
11.	Water supply and plumbing Sub-Committee BDC 24:1	V. A. Mhaisalkar (P) C. V. Chalpatirao (A)

1	2	3
12.	Drainage Sub–Committee BDC 24:2	S. K. Gadkari (P) V. P. Deshpande (A)
13.	Public Health Engg. Equipment Sectional Committee BDC 40	A. K. Seth (P) R. Paramasivam (A)
14.	Water treatment equipment Sub–Committee BDC 40:1	R Paramasivam (P) N. G. Swarnakar (A)
15.	Wastewater tretment equipment Sub–Committee BDC 40:2	A. S. Bal (P) S. D. Badrinath (A)
16.	Guiding committee for National Building Code BDC 64	S. K. Gadkari (P) P. Nema (A)
17.	Panel for plumbing services BDC 64:P–16	D. Raguraman (P) S. K. Gadkari (A)
18.	Composition of panel for industrial building BDC 64:P–21	S. K. Gadkari (P) R. C. Reddy (A)
19.	Panel for environmental pollution control BDC 64:P–23	R. S. Dhaneshwar (P) V. Haraprasad (A)
20.	Civil Engineering Division Council, CEDC	A. Raman (P) A. K. Seth (A)
21.	Chemical Division Council, CDC	P. V. R. Subrahmanyam (P) A. Ghosh (A)
22.	Water Sectional Committee CDC : 26	R. Paramasivam (P) M. V. Nanoti (A)
23.	Panel for sugar and food industries CDC 26:P–12	M. V. Srinivasan (Convenor) P. Kumaran (A)
24.	Panel for pulp and paper industry CDC 26 : P–13	P. V. R. Subrahmanyam (Convenor) A. S. Bal (A)
25.	Panel for leather and allied industries CDC 26:P–14	S. D. Badrinath (P) (Mrs). S. Satyanarayan (A)

1	2	3
26.	Panel for textiles and allied industries CDC 26:P-15	R. K. Pandit (P) S. S. Mudri (A)
27.	Panel for dye and dye intermediate Industries CDC 26:P-22	R. K. Pandit (P) S. S. Mudri (A)
28.	Panel for fertilizer industry CDC 26:P-16	K. L. Saxena (P) T. Chakrabarti (A)
29.	Panel for pesticides industry CDC 26:P-19	P. Kumaran (P) D. G. Kshirsagar (A)
30.	Panel for drugs, pharmaceuticals and fine chemicals industries CDC 26:P-20	J. S. Gadgil (P) R. K. Pandit (A)
31.	Panel for polymer based industries CDC 26:P-21	R. K. Pandit (P) T. K. Srinvasan (A)
32.	Panel for inorgaic chemicals based industries CDC 26:P-23	J. S. Gadgil (P) R. K. Pandit (A)
33.	Panel for sewage effluents CDC 26:P-24	A. Raman (Convenor) A. N. Khan (A)
34.	Panel for methods of test for water and effluents : CDC 26:P-1	
	i) Bacteriological and Viological methods	P. M. Phirke (P) S. R. Joshi (A)
	ii) Physical and chemical methods	S. P. Pande (P) M. V. Nanoti (A)
35.	Panel for treatment of water for cooling systems CDC 26:P-7	A. S. Bal (P) R. Sarin (A)
36.	Panel for glossary of terms for water CDC 26:P-8	S. G. Bhat (P) S. K. Kesarwani (A)
37.	Panel for mines and metal based industries CDC 26:P-18	K. L. Saxena (P) S. P. Pande (A)

1	2	3
38.	Panel for water filters CDC 27:3:P-1	P. Kumaran (P) N. Shivraman (A)
39.	Air Pollution Sectional-Committee CDC 53	A. L. Aggarwal (P) P. K. Yennawar (A)
40.	Terminology Sub-Committee CDC 53:1	S. K. Kesarwani (P) S. G. Bhat (A)
41.	Methods of sampling & analysis Sub-Committee CDC 53:2	P. K. Yennawar (P) G. H. Pandya (A)
42.	Ambient air quality sub-Coomittee CDC 53:3	V. L. Pampattiwar (P) N. S. Manthapurwar (A)
43.	Code of practice for control of air pollution CDC 53:4	A. L. Agarwal (P) G. H. Pandya (A)
44.	Micrometeorological technique and land use Sub-Committee CDC 53:5	V. L. Pampattiwar (P) S. Pentu Saheb (A)
45.	Emission standard for chemical fertilizer and petroleum industries CDC 53:P-2	A. L. Aggarwal (P) V. I. Pandit (A)
46.	Panel for emission standards for cement, glass & ceramic industries CDC 53:P-3	A. L. Aggarwal (P) N. S. Phadke (A)
47.	Panel to deal with 153 Documents CDC 53:P-4	K. R. Bulusu (P) P. K. Yennawar (A)
48.	Solid Waste Sectional Committee CDC 54	A. D. Bhide (Chairman) A. V. Shekdar (A)
49.	Panel for method of sampling & test for solid wastes CDC 54:2-6	S. K. Titus (P) V. P. Thergaonkar (A)
50.	Panel for steel mill solid wastes CDC 54:2:3	S. K. Titus (Convenor) M. S. Olaniya (A)
51.	Panel for flyash CDC 54:P-6	A. D. Bhide (P) S. K. Titus (A)

1	2	3
52.	Panel for solid wastes for ceramic & refractory industries CDC 54:P-8	M. S. Olaniya (P) A. D. Patil (A)
53.	Panel for solid wastes from coal mining and washery industries CDC 54:P-8	A. V. Shekdar (P) S. A. Gaikwad (A)
54.	Urban Solid Wastes Sub-Committees CDC 54:2	A. D. Bhide (P) S. K. Titus (A)
55.	Panel for collection, tranportation disposal & utilisation urban solid wastes CDC 54:2:5	A. V. Shekdar (Convenor) S. A. Gaikwad (A)
56.	Agricultural Residues and Rural Waste Sub-Committee CDC 54:3	C. K. Kale (P) A. S. Juwarkar (A)
57.	Environmental Protection Advisory Committee EPAC	K. R. Bulusu (P) P. V. R. Subrahmanyam (A)
58.	Panel for test equipment for waste quality LTDC 21:P-3	V. R. Bhave (P) V. R. Apte (A)
59.	Meteorological Instruments, Sectional-Committee EDC 69	V. Muralidhar (P) V. R. Bhave (A)
60.	Hygenic Codes Sub-Committee AFDC 36:5	P. V. R. C. Panicker (P) (Mrs.) A. S. Gadkari (A)
61.	Composition of Sub-Committee on Anti-Pollution device for pesticide residue EDC 38:20	V. S. Pandit (P) S. V Deshpande (A)
62.	Composition of expert panel on Methods of sampling for pesticide residue. AFDC 67-P-4	M. Z. Hasan (P) (Mrs.) N. Thakkar (A)
63.	Composition of Ad-hoc Group to examine the suitability of thin walled flexible quick coupling SMDD 22/AG-2	A. Raman (P) V. A. Mhaisalkar (A)

APPENDIX-VIII

MEMBERSHIP OF COMMITTEES

Sr. No.	Name of the Committee (Authority/Department)	Name of the Member/Representative
1.	Steering Committee for Engineering Colleges, Govt of Maharashtra	A. S. Bal
2.	Member, Advisory Board for the Narmada Planning Agency, Govt. of M. P.	A. S. Bal
3.	Task force for recommending creation of facilities for environmental research, M. P. Council of Science and Technology Bhopal	A. S. Bal
4.	Technical Advisory Committee, Assam Pollution Control Board : Member	A. K. Basu
5.	Chairman Committee for Developmant of of mobile and stationary laboratory for ENERO Office of Central Board for Pollution Control, New Delhi	A. K. Basu
6.	Committee Member for indepth ecological studies on the Hooghly stretch of the River Ganga of Central Board for Pollution Control, New Delhi	A. K. Basu
7.	West Bengal State Environment Committee, Calcutta	A. K. Basu
8.	Technical Advisory Committee on Air Pollution of West Bengal Pollution Control Board, Calcutta	A. K. Basu
9.	Technical Advisory Committee on Air Pollution and Water Pollution of Bihar State Pollution Control Board, Patna	A. K. Basu
10.	Expert in the study groups on :	A. K. Basu
	(a) Environment Sanitation and Health Care	

1	2	3
	(b) Waste Recycling, Sanitation of the West Bengal Science and Technology Commi. ttee – Government of West Bengal	A. K. Basu
11.	Committee on Science, Technology and Environment, Govt. of Kerala	C. S. G. Rao
12.	Technical Committee, Punjab Board for Control & Prevention of Water Pollution	A. Raman
13.	Committee of Ocean Pollution Control, organised by the Department of Ocean Development, New Delhi.	D. Raguraman
14.	Member – Technical Advisory Committee on 'Solid Fuels' of Deptt. of Non-Conventional Energy Sources, Govt. of India, New Delhi	A. D. Bhide
15.	Chairman of Expert Committee on Pulp and Paper Industry, constituted by Department of Environment, Ministry of Environment and Forests, New Delhi	P. V. R. Subrahmanyam
16.	Environmental Planning and Coordination Committee for the Ministry of Petroleum and Natural Gas.	R. Swaminathan
17.	Evaluation Committee for Technology Evaluation aud Norms in paper and pulp machinery : National Productivity Council, New Delhi	R. Swaminathan
18.	Nominated by NEERI, as member of a team appointed by Central Water Pollution Control Board to carry out EIA for proposed fertilizer plants to be sited at Kakinada, A. P,	R. Swaminathan & T. Chakrabarti
19.	Expert Committee of the Ministry of Urban Development for revising and updating of and manual on sewage treatment	S. D. Badrinath
20.	Task force on Bio-gas generation from 'Night Soil', Deptt. of Non-Conventional Energy Source, Govt. of India	S. D. Badrinath

1	2	3
21.	Member of Steering Committee on Ganga Action Plan, Govt. of India	S. D. Badrinath
22.	High Level Technical Committee : National Institute of Hydrology, Roorkee	V. P. Thergaonkar
23. (i)	National Committee on Development of Methods for gainful utilisation of community and industrial waste-waters for irrigation, Central Board for Prevention and Control of Pollution	G. B. Shende
(ii)	Pesticides Environmental Pollution Advisory Committee, Ministry of Agriculture, Govt. of India	G. B. Shende
24. (i)	National Committee on Wastewater Quality Monitoring instruments set up by Central Board for Control of Water Pollution, New Delhi	R. Sarin
(ii)	Expert Committee for setting up National Environmental Monitoring Organization (NEMO) in India, Deptt. of Environment & Forests, New Delhi	R. Sarin
(iii)	Expert Committee for drawing out a Comprehensive Plan on Manpower Development & Training, Ministry of Urban Development, Govt. of India, New Delhi	R. Sarin
25.	Advisory Committee on Environmental Planning and Coordination of the Ministry of Petroleum and Natural Gas, Govt. of India, New Delhi	K. S. M. Rao
26.	Member, Biogas from Industrial Wastewater, Deptt. of Non-Conventional Energy Resources, New Delhi	S. N. Kaul
27. (i)	Expert Member in the Sulabh Technology Advisory Group	S. D. Badrinath

1	2	3
	(ii) Expert Committee by the Sulabh International to provide guidance on various aspects of soil and water pollution from on-site sanitation facilities – one year	S. D. Badrinath
	(iii) Project advisory committee for R & D Projects in the field of Bio-gas technology, Sulab International, Patna	S. D. Badrinath
28.	Expert Committee on Land disposal of disposal of paper mill wastewater of Hindustan Paper Corporation	A. S. Juwarkar
	(i) Member – Academic Sub–committee of M. Phil. Course (Environmental Science) Calcutta University	A. K. Basu
	(ii) Member, Advisory Committee of Ocean Development & Environment, constituted by Jadhavpur University	A. K. Basu
29.	(i) Faculty of Engineering Studies, University of Science & Technology, Cochin	C. S. G. Rao
	(ii) Technical Advisory Committee of Karnataka State Pollution Central Board	C. S. G. Rao
	(iii) Emergency plan to abate ammonia pollution set up by District Collector – Ernakulam	C. S. G. Rao

APPENDIX-IX

HONOURS & AWARDS

Sr. No.	Name	Award/Honour/Degree	Awarded by, Programmee & Purpose
1.	2.	3.	4.
1.	Dr. S. R. Joshi	Member on Board of Studies in Zoology of Marathwada University, Aurangabad for a period of three years	Marathwada University, Aurangabad
2.	Dr. R. Sarin	Dwight Eisenhower Fellow for the year 1987 from India. Invitation to visit USA for three months	Eisenhower Exchange Fellowships Inc. USA. July 1986
3.	Dr. K. Surya Mohan Rao	Invited to accompany High Power Delegation to USSR under S & T programme	Indian Meteorological Dept., Govt. of India, November. 1986
4.	Dr. R. Sarin	Appointed Member of JTG for section of Standard Method for Examination of Water	Standarrd Method Committee of IWWA, WPCP. IPHA
5.	Shri V. P. Thergaonkar	Ph. D. in Chemistry. Thesisentitled Chemical nature of clays and their role in coagulation. His research guide was Dr. O. B. Thakre, former Professor of Chemistry, Institute of Science. Nagpur	Nagpur University
6.	(Mrs.) Bhanumati Swamy	Cash Award of Rs. 450/– for passing Hindi (Praveen) Exam.	NEERI
7.	Dr. K.P. Krishnamoorthi	1) Editorial Boards i) Academy of Environmental & Pollution Research	
		2) Member of Boards of Studies of : i) Bhopal University, Sub : Limnology	Bhopal University
		ii) Bharathiar University, Coimbatore (T. N.) Sub : Zoology	Bharathiar University Coimbatore

8. Dr. S. R. Joshi & Dr. N. Shivraman	Co-opted as Members of Board of Studdies in Biochemistry & Microbiology.	Nagpur University
9. Shri S. D. Deshpande	Awarded Ph. D, in Chemistry, Thesis entitled "Studies on Biodegradation of some organic chemical industries in aqueous system" His research guide was Dr. Tapan Chakrabarti, Scientist, NEERI.	Nagpur University
10. Shri R. K, Pandit	Awarded Ph. D. in Chemistry. Thesis entitled "Studies in wastewater treatment with particular reference to chemical aspects involved". His research guide was Dr. M. S. Mayadeo, Head, Dept. of Chemistry, Ramnarain Ruai Collage, Bombay.	Bombay University
11. Shri S. D. Badrinath	Awarded Ph. D. in Civil Engineering. Thesis entitled "Anaerobic Contact Upflow Reactor for the Treatment of Distillery Waste". His research guide was Dr. S. N. Kaul. Scientist & Head. Wastewater Engineering Division, NEERI	Nagpur University
12. A. N. Khan	Award for Best Paper entitled "Anaerobic Suspended and Attached Growth Systems for Wastewater Treatment" presented at Bangalore in Feb. 1987	National Convention of the Institution of Public Health Engineers (India)

APPENDIX–X

DEPUTATION ABROAD

Sr. No.	Name	Programme and Date
1.	Shri R. Paramasivam	Invited as expert to deliver lectures in training courses held at Asian Institute of Technology, Bangkok organised by CEFIGRE, France, in two assignments, May 12 & July 1–2, 1986
2.	Shri A. V. Shekdar	Deputed under the Colombo Plan to Japan for training in Solid Waste Management and Night Soil Treatment, May 26 to August 1, 1986
3.	Dr. G. B. Shende	Deputed to Jordan as FAO Consultant for Wastewater Utilization in Agriculture, July 25 to August 15, 1986
4.	Shri P. S. Kelkar	Deputed under the Government of Netherlands offer of training under the Netherlands Fellowship Programme for course in Sanitary Engineering I & II at the International Institute for Hydraulic & Environmental Engineering (IHE) Delft, The Netherlands October 1986 to Sept 1987
5.	Dr. K. Surya Mohan Rao	Deputed to USSR, to accompany official delegation to Moscow, led by Director General, Meteorological Department to finalise projects under the Indo-USSR Cooperation in Science & Technology on Meteorology, Nov. 9–15, 1986
6.	Prof. P. Khanna	Invited to Bangkok, to attend organisational meeting on NIEM, UNEP, March 9–12, 1986
7.	i) Dr. K. Surya Mohan Rao ii) Shri V. Muralidhar	Deputed to USSR, to attend a training course on Integrated Planning, for Human Settlements to improve environmetal conditions, March 17–27, 1987

APPENDIX-XI

PATENTS

Sr. No.	Patents	Inventor & Date of Filing
1.	An Improved Device for Aeration of Liquids	S. N. Kaul & H. J. Patil
	Patent No. DEL/351/86	21-4-1986
2.	An Improved Rotating Biological Rope Contactor for the treatment of Biodegradable wastes	A. S. Bal, A. N. Khan, H. J. Patil & A. C. Manuel
	No. DEL/90/86	17-3-1986

APPENDIX-XII

BUDGET

Actual Expenditure 1986-87

(Rupees in Lakhs)

Capital	:	Plan	...	81.396
		Non-Plan	...	2.672
Recurring	:	Plan	...	11.300
		Non-Plan	...	205.595
Total	:	Plan	...	92.696
		Non-Plan	...	208.267
Grand Total :			...	300.963

APPENDIX-XIII

VISITS OF WHO FELLOWS

1.	Mr. Abul Ghafore Chief of Toxicological Laboratories Sanitary Station Afganistan	July 21 - Aug 14, 1986
2,	Mr. Md. Shahjahan Mallick DPHE, Bangladesh	Sept. 8–12, 1986
3.	Mr. Quazi Khawaza Baksh Executive Engineer DPHE 12/C, Dilksha C/A Dhaka, Bangladesh	Sept. 8–12, 1986
4.	Mr. Md. Shamsul Huda Executive Engineer DPHE 12/C, Dilksha Motijheel C/C Dhaka, Bangladesh	Sept. 8–12, 1986

APPENDIX-XIV

STAFF

As on March 31, 1987

Scientific	:	222
Technical	:	214
Administrative	:	150
Total	:	586

APPENDIX–XV

DISTINGUISHED VISITORS

Sr. No.	Name	Date (s)
1)	Mrs. Gita Mukherjee Member of Parliament New Delhi	May 14, 1986
2)	Mr. Norman J. Weinstein Resource & Environment Conservation New England, Workster MA 0131, UK	Sept. 18, 1986
3)	Mr. Shantaram Potdukhe Member of Parliament New Delhi	Oct. 3, 1986
4)	Mrs. Leena Mehendale, IAS Managing Director, Western Maharashtra Development Corporation Ltd., Pune	Oct. 9, 1986
5)	Hon'ble Mr. Bhawani Mukherjee Minister of Environment, Government of West Bengal, Calcutta	Oct. 22, 1986
6)	Mr. Anil Agarwal Centre for Science & Environment New Delhi	Dec. 11, 1986
7)	Mr. Naigzy Gebremedhin UNEP Nairobi	Feb. 23–25, 1987
1)	Mr. Khawani Shahzi Vice–President of Intermediate Medical Education Institute, Kabul, Afghanistan	March 4–13, 1987