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**INDIAN THERMAL TREATMENT SYSTEM
ENVIRONMENTAL BUSINESS EXCHANGE**

**India
January 17 to February 23, 1994**

Prepared for:

US - ASIA ENVIRONMENTAL PARTNERSHIP



WORLD ENVIRONMENT CENTER

DISCLAIMER

This project was sponsored by the U.S. Agency for International Development through a Cooperative Agreement with the World Environment Center (WEC) in support of the U.S.-Asia Environmental Partnership (US-AEP). The opinions expressed herein are the professional opinions of the author and do not represent the official position of the Government of the United States of America or the World Environment Center.

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I. EXECUTIVE SUMMARY

At the request of Pure Tech Engineering, Pvt. Ltd. (Pure Tech) and Cyno Clean Company, Pvt. Ltd. (Cyno Clean), affiliated firms that are both headquartered in Madras, India, Mr. Alan Baker and Mr. Prakash Acharya traveled to India to participate in an Environmental Business Exchange (EBE). Both exchange participants represent IT Corporation of Knoxville, Tennessee. Mr. Baker is the Business Development Manager for the Pollution Control Engineering Division (PCE), and Mr. Acharya is a technical specialist in the environmental area. The purpose of the EBE was to provide technical assistance in the field of hazardous waste incineration, and to identify and solve problems posed by the construction and operation of a hazardous waste incinerator in Madras, India.

India's industrial base has been growing at a rapid pace, particularly near the large urban centers of New Delhi, Bombay, Calcutta, and Madras. This growth has resulted in the generation and accumulation of large quantities of hazardous waste, posing a threat to human health and the environment. In response to the need for environmentally sound wastewater management, Pure Tech was founded to provide consulting and project management services in the area of wastewater treatment. Recently, Pure Tech has been promoting Cyno Clean for coordinating a centralized incinerator system for treating toxic and hazardous waste generated by industries in and around Madras. In December of 1993, representatives of Cyno Clean visited the U.S. under the auspices of the US-AEP, through WEC. During this trip, they were introduced to IT Corp. and entered into a Memorandum of Understanding for the purchase of a waste treatment system.

The intent of this visit was, first, to gain a thorough understanding of the current environmental climate to better assess the most pressing environmental problems in the Madras area. Secondly, this visit allowed the experts to describe the available U.S. waste treatment technologies, including incineration, and to suggest solutions to problems faced in the south of India.

Funding for this project was provided through a Cooperative Agreement between the World Environment Center (WEC) and the United States-Asia Environmental Partnership (US-AEP).

II. INTRODUCTION

In response to a request by Pure Tech Pvt. Ltd., and Cyno Clean Company Pvt. Ltd., both headquartered in Madras, India, Mr. Alan Baker, Business Development Manager for IT Corporation's Pollution Control Engineering Division, and Prakash Acharya, an IT Corporation technical specialist in the environmental area, visited India. The purpose of this trip was twofold: (1) to gain a thorough understanding of the current environmental climate in the Madras area, allowing the experts to better assess the most pressing environmental problems, and (2) to describe the available U.S. technologies, including incineration and pollution prevention, to the Indian industrial community, and to suggest solutions to the existing environmental problems. During the visit, Messrs. Baker and Acharya met with representatives of various industries in the Madras area, state and federal regulatory personnel, local and state government officials, bankers, and promoters. Major industries located in the Madras area include refineries, fertilizer complexes, petro-chemical plants, tanneries, and others.

This report describes IT Corporation's environmental problem-solving mission to India from January 17 through February 23 under the auspices of the US-AEP, through its Cooperative Agreement with WEC.

IT Corporation is a technology-based, full-service, internationally established organization whose business is solving environmental problems. Messrs. Baker and Acharya have expertise in incineration and other hazardous waste processing technologies.

Pure Tech (India) Pvt. Ltd., a wastewater treatment consulting and management firm, was established 8 years ago by Mr. B. Ravi, Managing Director. The company has conducted more than 600 treatment studies for various kinds of industrial effluents and sewage in Southern India. In addition to undertaking such studies, Pure Tech also provides project management, consulting, and equipment supply services.

As Pure Tech's subsidiary, Cyno Clean has been charged with setting up a centralized incinerator system to treat industrial and toxic wastes generated by industries in and around Madras. Cyno Clean approached Industrial Credit and Investment Corporation of India (ICICI), Bombay, for assistance under the Trade in Environmental Services and Technologies (TEST) program. ICICI recommended Cyno Clean's proposal to the U.S.-Asia Environmental Partnership (US-AEP).

When Cyno Clean representatives visited the U.S. in December, 1993 in a previous Environmental Business exchange, they held detailed discussions with IT Corporation and entered into a Memorandum of Understanding for the purchase of a hazardous waste incineration system from IT Corporation. During IT Corporation's follow-up trip to Madras, the company and Cyno Clean also discussed the supply of a turn-key incineration system to dispose of industrial wastes in the area. They met with Cyno

Clean's potential customers the industries that generate hazardous waste, the bankers, and the regulators. At the end of their trip, IT Corporation submitted a detailed technical/commercial proposal for the supply of technology and equipment.

III. DISCUSSIONS AND FINDINGS

A. INTRODUCTION

This section summarizes the meetings and site visits held during this exchange. IT Corporation experts held meetings in conjunction with the key personnel of the Cyno Clean incinerator project. The key meetings took place in Bombay and were with the representatives of ICICI, the potential investment banker for the proposed project, and with the executives of Reliance Industries Ltd., the fourth largest industrial conglomerate in India and a potential client to IT Corporation.

The key meetings held during the week in Madras included the following: a high-profile seminar during which the experts addressed the potential Cyno Clean clients; a meeting with executives of Madras refineries, the largest potential supplier of waste to the Cyno Clean incinerator; a meeting with representatives of the Tamil Nadu Pollution Control Board that enforces the existing pollution control laws in the state; and a meeting with Fuller-KCP, the prime IT Corporation subcontractor responsible for the detail engineering, procurement of indigenous equipment, and installation of the incinerator at the Madras site.

B. KEY MEETINGS

1. Reliance Industry, Ltd. - January 17, 1994

Present: P. Acharya (IT); A. Baker (IT); B. Ravi (Cyno Clean); R. Narasimhan (Protech Consultants); P.N. Devarajan (Reliance-President); K. Ramamurthy (Reliance-PVC Group)

Reliance Industries, Ltd. (Reliance), headquartered in Bombay, is the fourth largest and fastest growing industrial conglomerate in India. The firm has two large industrial complexes located in Hazira (Gujarath) and in Patalganga (Bombay). Primarily in the plastics business, Reliance appears to be a progressive and environmentally responsible company.

McGill Environmental, a former division of IT Corporation, supplied a fume incinerator to Reliance in 1992 that is currently being operated at the Hazira location. Pure Tech believes that Reliance may need more incinerators at the Hazira complex, and in other locations. Reliance may also need IT Corporation's consulting services on waste prevention and minimization.

The purpose of the meeting was to consult with the firm's top executives and explore possible future business relationships with IT Corporation and Pure Tech. Reliance

executives reported on their products and their short-term expansion plans. These executives stated that IT Corporation's services may be needed in the future.

Mr. Devarajan discussed the capacity-related problems with the fume incinerator supplied by IT-McGill. Since he was unsure of the extent of the problems at Hazira, or the need for IT Corporation's services at Hazira, and Patalganga, Mr. Devarajan suggested that the IT Corporation experts visit the two locations. Mr. Ravi agreed to schedule a visit to both locations during the second half of February. Mr. Devarajan wanted the technical personnel at the site to evaluate the need for IT Corporation's services before any executive decisions were made at headquarters.

2. Industrial Credit and Investment Corporation of India, Ltd. (ICICI) - January 17, 1994

Present: P. Acharya (IT); A. Baker (IT); B. Ravi (Cyno Clean); R. Narasimhan (Protech Consultants); K. Harinathan, (Manager, ICICI); A. Palkar (Assistant Manager, ICICI); Mr. Advani (General Manager, ICICI)

Mr. Baker stated to Mr. Harinathan that the budgeted lump sum price for the proposed incinerator project was US\$17 million. Mr. Ravi of Cyno Clean and the Industrial Credit and Investment Corporation of India previously agreed to a debt-to-equity ratio of 3:1 for the project. The equity portion will be invested by Mr. Ravi, promoters, and public offerings. Mr. Harinathan stated in the meeting that ICICI will only consider financing the debt portion of the project cost once Cyno Clean submits a formal project profile report. Mr. R. Narasimhan of Protech was assigned to prepare the report at the earliest possible date.

The IT Corporation representatives also met with Mr. Advani in a separate meeting and had a detailed discussion about the proposed incinerator project. Mr. Advani said that ICICI is interested in financing the project for environmental reasons even though it is a developmental project and involves some risk.

3. Potential Cyno Clean Clients - January 18, 1994

Present: P. Acharya (IT); A. Baker (IT); B. Ravi (Cyno Clean); R. Narasimhan (Protech Consultants); Mr. Harinathan, Pure Tech/Cyno Clean; More than 30 representatives from various industries in the Madras area; Government and Regulatory board representatives

This formal meeting was hosted by Cyno Clean for the benefit of its potential customers to discuss the purpose of, and the need for the proposed incinerator, the Indian Thermal Treatment System (ITTS). Mr. Harinathan spoke on ICICI's policies and investment approach as well as its role in the proposed project. A representative from the Tamil Nadu Pollution Control Board stressed the need to install an incinerator

to clean up the Madras area.

Mr. Baker discussed IT Corporation and the IT PCE group, a subsidiary of IT Corporation that is responsible for supplying the turn-key incinerator to Cyno Clean. In addition, Mr. Baker discussed the project structure and the Indian content participation to lower the project cost. He also discussed incineration technology in general. Mr. Acharya, discussed different components of the ITTS. The IT Corporation representatives answered questions in a detailed manner to ensure that the audience understood the issues. Cyno Clean video taped the proceedings of the entire meeting and assembled an album with still photographs. Mr. Ravi later told the IT Corporation experts that he believed it was a successful meeting based on the comments from the audience.

4. Meeting with Madras Petrochem, Ltd. - January 19, 1994

Present: P. Acharya (IT); A. Baker (IT); B. Ravi (Cyno Clean); R. Narasimhan (Protech Consultants); M. Narayanan (Refinery Manager, Madras Petrochem); N. Bala Subyamanya (Manager, Technical Services, Madras Petrochem)

Mr. Narayanan reported that Madras Petrochem, Ltd. (MPL) generates waste in the form of sludge which ultimately settles in a large lagoon. The sludge, with an acidity of 70 to 75 percent, consists of coke, sulfur dioxide (SO₂), and hydrocarbons. According to Mr. Narayanan, the sludge polymerizes and settles at the bottom of the lagoon. MPL hopes to convert 70 to 80 percent of the waste into single superphosphate, a fertilizer, and a saleable product. The rest would be used by MPL as a fuel in cement and lime kilns.

IT Corporation experts indicated they do not believe MPL can separate the waste and convert it into a saleable product. Even if MPL can accomplish its objective, the soil underneath the lagoon bottom is contaminated according to the IT Corporation experts. They estimated the quantity of the contaminated soil to be 20,000 tons if the soil is contaminated up to 4 inches deep.

MPL stated that it intends to accomplish its objective in the next 1.5 to 2 years. IT Corporation experts believe that this is aggressive, and MPL may have to ship the wastes, including sludges and contaminated soils to ITTS for incineration. MPL may not have adequate funds for the cleanup.

5. Cyno Clean Company - January 19, 1994

Present: P. Acharya (IT); A. Baker (IT); B. Ravi (Cyno Clean); R. Narasimhan (Protech Consultants)

Mr. Ravi, Managing Director of Cyno Clean, told the IT Corporation experts that the estimated project cost of \$17 million is high and the project cost should be reduced to approximately \$8-10 million. Mr. Baker suggested that the project cost can be lowered by reducing the incinerator capacity. However, IT Corp. does not recommend reducing the incinerator capacity due to its detrimental effect on project economics.

Per Mr. Ravi's request, Mr. Baker agreed to delay the installation of boiler and turbo-generator package until a future date and to reduce the incinerator capacity from 30,000 to 20,000 metric tons per year (MTPY). The ITTS configuration and the average heating value of the waste (9000 Kcal/kg) remained the same. Mr. Baker agreed to prepare a revised technical and business proposal within a month.

6. Fuller-KCP, Madras - January 20, 1994

Present: A. Baker (IT); R. Narasimhan (Protech Consultants); B. Ravi (Cyno Clean); S.S. Siddu; K. Prasad Rao; Mr. Jeyakumar

Fuller-KCP is the prime engineering contractor for engineering procurement and installation of ITTS. Fuller-KCP was asked to maximize the indigenous source of equipment and restrict the import to only critical items. IT Corporation is the process licensor and will provide the complete process and technical details as a basic engineering package to Fuller-KCP.

Mr. Baker informed Fuller-KCP of the reduced scope of supply and the downsizing of ITTS. Mr. Ravi and Mr. Baker asked Fuller-KCP to reduce the Fuller-KCP's costs to the maximum extent possible so that project costs will be approximately US\$8-10 million. Fuller-KCP agreed to aggressively pursue methods to cut costs.

7. Tamil Nadu Industrial Development Corporation (TIDCO) - January 21, 1994

Present: P. Acharya (IT); A. Baker (IT); B. Ravi (Cyno Clean); R. Narasimhan (Protech Consultants); Aravind (Chairman, TIDCO)

Mr. Ravi informed Mr. Aravind that the equity involvement is 25 percent of the total project cost. Mr. Aravind indicated that TIDCO is interested in the equity participation partly because it is an environmental project. Clearly, environmental projects are favorably considered at the present time in India.

C. ADDITIONAL MEETINGS

Mr. Ravi, Managing Director of Cyno Clean, requested IT Corporation's technical expert meet with the potential clientele supplying the wastes to the proposed incinerator. He further recommended concentration on both large and small waste generators. The large waste generators such as Madras Refineries, Ltd. will provide the core business to the incinerator, while the small generators will provide a small quantity, but a high-margin waste, to Cyno Clean. Also, the Tamil Nadu Pollution Control Board would like Cyno Clean to serve both large and small generators in order to service the entire Madras area while providing a valuable service to the chemical industry. The IT Corporation representative met primarily with the small generators during the week of January 24, 1994.

1. Bharath Heavy Electricals, Ltd. (BHEL) - January 22, 1994

Present: P. Acharya (IT); B. Geetha (Cyno Clean); R. Narasimhan (Protech Consultants); Gunaseelan (BHEL)

Mr. Acharya, Mr. Narasimhan, and Ms. Geetha met with Mr. Gunaseelan, Deputy General Manager of BHEL, to discuss the supply of a boiler and the turbo-generator package to Cyno Clean. Mr. Acharya provided the technical specifications to Mr. Gunaseelan. Mr. Gunaseelan scheduled a meeting for January 28 between Mr. Acharya and the BHEL engineers to discuss the technical and pricing aspects of the boiler/turbo-generator packages.

2. Tractors and Farm Equipment (TAFE) - January 24, 1994

Present: P. Acharya (IT); G. Geetha (Cyno Clean); Narasimhan (Protech Consultants); R. Ramachandran (TAFE)

TAFE was built in the 1950s in collaboration with NAS Ferguson, U.K. TAFE manufactures farm tractors of various sizes and horse power. Wastes (liquids and sludges) are generated in a metal-hardening plant. Until the 1970s, wastes were disposed of offshore. TAFE built a wastewater treatment plant in the 1970s to clean up the aqueous wastes.

At the present time, TAFE has accumulated 160 tons of cyanide waste and is generating waste at a rate of 36 tons per year. The waste streams include: sludge containing traces of cyanide and barium salts from various tanks; treated sludge (without cyanides) containing inorganics; shot blast dust (iron and cyanide up to 15 parts per million [ppm]); mild steel pots containing traces of cyanides (unsuitable for incineration); and oils containing cyanides, carbon dioxide (CO₂), and nitrogen (N₂)

from sodium cyanide.

The bulk of the wastes listed can be processed in the TTTS, but some are clearly unsuitable (metallic, inorganic wastes, etc). TAFE requested that Cyno Clean provide them with the disposal costs (Rupees/ton).

3. Lucas-TVS - January 24, 1994

Present: P. Acharya (IT); B. Geetha (Cyno Clean); R. Narasimhan (Protech Consultants); V.N. Loganathan, Chief Chemist (LUCAS-TVS); C. Krishna (Chief Materials Manager, Lucas-TVS)

This truck manufacturer has a metal-hardening plant that uses a nitriding process. The former process, used until 1986, contained 22 percent cyanide in the waste. The current process produces waste that contains less than 2 percent cyanides. A new system to be installed in 1995 will produce cyanide-free wastes.

The company's accumulated cyanide waste is 3 tons; however, no continuous generation of waste is expected in the future. LUCAS-TVS requested that Cyno Clean quote a price for disposal.

4. Southern Petrochemicals Industries Corporation (SPIC) - January 25, 1994

Present: P. Acharya (IT); B. Geetha (Cyno Clean); R. Narasimhan (Protech Consultants); and a SPIC representative

SPIC is a large corporation that produces inorganic chemicals. Inorganic sludges wastes contaminated with mercury (Hg) are generated. The disposal option for this type of waste is stabilization and solidification. Cyno Clean intends to install such a plant in 3 to 5 years. SPIC expressed its interest in shipping the waste to this plant when the plant is completed and in operation. The accumulated waste amount is approximately 2,700 tons: SPIC will continue to produce 900 tons per year for the next 3 years. After 3 years, SPIC intends to install a system involving a membrane process that renders the sludge nonhazardous.

5. Manali Petrochemicals, Ltd. - January 25, 1994

Present: P. Acharya (IT); B. Geetha (Cyno Clean); R. Narasimhan (Protech Consultants); S. Abdul Samad (Deputy Manager, Operation, Manali Petrochemicals)

Manali Petrochemicals, Ltd. (MPL) currently produces propylene products and other

polymers and currently operates a 2 ton-per-hour liquid/fume incinerator. By next year, MPL plans to convert fumes into pesticides, a saleable product. Liquid wastes consisting of 50 percent organics and 50 percent inorganics such as magnesium silicate, are currently incinerated at a rate of 16 tons per year. Manali Petrochemicals agreed to send the liquid waste to Cyno Clean when ITTS is completed and in operation. The existing liquid incinerator will then be shut down permanently.

6. Tamil Nadu Pollution Control Board - January 27, 1994

Present: P. Acharya (IT); B. Greetha (Cyno Clean); R. Narasimhan (Protech Consultants); R.D. Pillai (additional chief engineer, Tamil Nadu Pollution Control Board)

Mr. Pillai and Mr. Acharya discussed the technical and regulatory issues posed by the proposed incinerator. Mr. Pillai said that he anticipates that the Board will stringently enforce the existing regulations. The Board gave its strong support to Cyno Clean's efforts in the Madras area.

7. BHEL - Trichy location - January 28, 1994

Present: P. Acharya (IT); R. Narasimhan (Protech Consultants); N. Kamalanathan (Sr. Deputy General Manager, BHEL), N. Subramanyam (Sr. Manager), and G. Pandian (Manager, Commercial, BHEL)

BHEL, an ISO 9000 certified company, is primarily in the business of supplying turn-key thermal power plants for the domestic and foreign market. BHEL employs 30,000 people located in four different states. BHEL has a large engineering and fabrication facility to manufacture boilers and heat exchangers located in Trichy, and a large facility to manufacture turbo-generators for power plants located in Hyderabad; two other facilities are located in the northern part of India.

The IT Corporation experts met with BHEL's technical and commercial personnel to discuss the supply of a boiler and turbo-generator package on a turn-key basis. BHEL, primarily makes water-tube boilers for power plants, and it has built several fire-tube boilers for Indian and overseas markets.

After a detailed technical discussion with BHEL engineers, and a 2-hour facility tour, Mr. Acharya believed that BHEL can supply a turn-key boiler and turbo-generator package for the proposed incinerator. A week later, BHEL submitted a formal technical/commercial proposal to Cyno Clean. Fuller-KCP, IT Corporation's prime subcontractor responsible for purchasing indigenous equipment, will invite bids from other Indian equipment suppliers before the final equipment supplier selection is made.

8. Mangalore Chemicals and Fertilizers Ltd. (MCF) - February 7, 1994

Present: P. Acharya (IT); S. Satyanarayan (Sr. Vice President-Works), Prashanth Kumar (Deputy General Manager, MCF); M. Sadalga (Sr. Manager, MCF)

MCF produces ammonia, urea, and diammonium phosphate (DAP). Fertilizer plants typically deal with inorganics; therefore, wastes applicable for incineration are minimal.

Mr. Acharya gave a 1-hour presentation at MCF on "Incineration of Hazardous Wastes in the U.S.A." The audience included managers, plant engineers, and other operating personnel.

9. Institution of Engineers - India (Mangalore Chapter) - February 15, 1994

At the request of Institution of Engineers, Mr. Acharya delivered an hour-long speech on "Incineration of Hazardous Wastes in the U.S.A." The audience included engineers working in different industries in the Mangalore area.

10. Reliance Industries Ltd. - Hazira and Patalganga locations - February 23

Present: P. Acharya (IT); R. Narasimhan (Cyno Clean); Gopalakrishna (Technical Services Director of Reliance)

Reliance operates large chemical complexes at Hazira (Gujarath state) and at Patalganga (near Bombay). At both of these locations, Reliance operates vinyl chloride monomer (VCM) and polyvinyl chloride (PVC) plants, in addition to manufacturing other chemicals. The vapors from the VCM and PVC plants are fed to a fume incinerator located at the Hazira facility.

At the suggestion of the Reliance executives in Bombay, during a January 17, 1994 meeting, a visit by the IT experts to the Hazira plant was arranged. The purpose of the meeting was to offer IT Corp.'s technical assistance to remedy the problems with the IT/McGill-supplied fume incinerator and to discuss Reliance's need for an incinerator in the future.

The technical services director told Mr. Acharya that the fume incinerator was commissioned in 1992. The incinerator was designed to handle liquids and vapors at a maximum thermal rating of 8.6 million kilocalories/hour and a total waste feed rate of 1000 kilograms/hour. The air pollution control system was designed to produce a purge stream of 18 percent hydrochloric acid (HCl).

In practice, however, the on-stream factor for the incinerator is 70 and 95 percent

when liquid and vapor, or vapors only, respectively, are incinerated. The maximum waste feed rate is 400 to 600 kilograms/hour versus a design capacity of 1000 kilograms/hour. The on-stream factor is reduced to 70 percent when liquids are fired due to leaks in the two bellows located between the boiler and the quench. Reliance is considering installing Hastelloy bellows instead of the fibrous material bellows used at this time. At present, the liquids are not incinerated; they are being stored.

CONCLUSIONS AND BUSINESS DEVELOPMENT UPDATES

Conclusion 1: Follow-up marketing assistance is needed. This is a first of a kind market entry.

Update 1: Madras Refineries has agreed to provide 12,000-20,000 tons of wastes. This is the critical "anchor tenant" needed to secure loans.

Update 2: ICICI has given Preliminary Loan Approval (June, 1994).

APPENDIX A

CURRICULUM VITAE

Alan C. Baker

Professional Qualifications

Mr. Baker manages projects/divisions/companies using high temperature combustion process technology. Experience covers international marketing, technical development, commissioning and trouble-shooting assignments. He is an IT Senior Project Management Associate.

Education

B.S., Applied Mineral Sciences, Leeds University, Leeds, England; 1973
Short Courses (USA, RSA) in Industrial Relationships, Leadership
40-Health and Safety Training: OSHA (29 CFR 1910.120)

Experience and Background

- 1992 - *Manager, Business Development, Pollution Control Engineering Division, IT Corporation, Knoxville, Tennessee.* Responsible for generating and sustaining revenues balanced by technology application, project size and scope, project location and commercial and government work. Chartered to promote revenue growth and enhanced profitability by focus on, and selection of, opportunities with high "win" probability and by identifying and overcoming barriers to growth.
- 1991 - *Deputy Project Director, IT Motco, LaMarque, Texas.* Responsible for all aspects of operations and maintenance of Superfund, hazardous waste incinerator, utilizing rotary kiln/secondary combustion chamber system. Elevated throughput and availability. Introduced improved cost and operations records and reports. Recognized line reporting structure to ensure functional accountability. Managed site demobilization at conclusion of IT site work.
- 1992
- 1991 - *General Manager, Standard Foundry, Benoni Tvl., South Africa.* Responsible for all aspects of 570 man specialty steel foundry. Restructured organization, cut costs and established profitability of Standard Foundry for new owners - Scaw Metals Ltd.
- 1990 - *Plant Manager, Scaw Metals, Johannesburg, South Africa.* Contracted to resolve personnel, technical and operating problems on R85 million rotary kiln plant. Completed two year plan assignment in 8 months. Relocated to South Africa for this work.
- 1991
- 1986 - *Vice President, MERC, Knoxville, Tennessee.* Mining and manufacturing firm's first employee. Hired work force, established management procedures. Developed and implemented sales/marketing and business plans.
- 1990

- 1990 - **Technical Consultant, Green Cove Springs, Florida.** Completed raw material search for feasibility study directed at establishing Synthetic Rutile Production in Eastern USA. Communicated USA studies to Australian process developers.
- 1991
- 1985 - **Vice President and General Manager, Norcarbon, Inc., Rockwood, Tennessee.** Turnkey project manager for rehabilitation and conversion of idle high temperature plant. Hired workforce, established organization and controlled cash flow. Project completed on time and within 2 percent of budget. Worked with civic leaders to generate appropriate corporate image. Assisted in permitting construction and operations in borderline "unclassified" area. Supervised cold and hot recommissioning.
- 1990
- 1983 - **Marketing Manager, Davy McKee, Pittsburgh, Pennsylvania.** Developed applications research for newly formed division. Assisted in technical marketing of licensed Japanese steel-making technology and innovative water purification process. Promoted technology in South Africa during one year residency for commissioning and employee training of \$30 million plant. Created and delivered technical presentations in support of international marketing effort. Designed and cost air pollution control systems.
- 1985
- 1977 - **Senior Process Engineer, DRC, Rockwood/Knoxville, Tennessee.** Transferred operating and plant scale-up technology from Australian developers to American licensors. Wrote comprehensive technical and plant operating manuals. Developed mathematical and computer models. Obtained technical patents to support and protect technical marketing effort. Planned and executed plant-scale test programs.
- 1983
- 1973 - **Plant Metallurgist, Western Titanium Ltd., Capel, Western Australia.** Responsible to Plant Manager for process control and plant performance of Synthetic Rutile production facility.
- 1977

Professional Affiliations

American Institute of Mining and Metallurgical Engineers, Iron and Steel Society

Publications

Mr. Baker has eight technical patents and various technical papers in support of Commercialization of "DRC" Rotary Kiln Technology .

Prakash Acharya, PE, CHMM

Professional Qualifications

Mr. Acharya is a chemical engineer with 21 years of experience in hazardous waste incineration processes, chemical process development, design of equipment, heat and mass balance calculations, commissioning of pilot and commercial plants, economic analysis of process alternatives, equipment selection and writing specifications, and piping and instrumentation diagrams (P&IDs). His experience includes 13 years of designing, permitting, operating, research and development (R&D) of transportable and fixed facility incinerators. Mr. Acharya also has diversified industrial experience in troubleshooting, design, (R&D), and production. He is familiar with a broad range of processes manufacturing nitrogenous and phosphatic fertilizers and defines and solve challenging and difficult process-related problems.

Education

M.S., Engineering Management, University of Missouri, Rolla, Missouri; 1982
M.S., Chemical Engineering, University of Missouri, Rolla, Missouri; 1980
B.S., Chemical Engineering, Banaras University, India; 1972
40-Hour Health and Safety Training: OSHA (29 CFR 1910.120)

Registrations/Certifications

Registered Professional Engineer: Tennessee (1983)
Certified Hazardous Materials Manager (1986)

Experience and Background

1987 - Present - **Staff Consultant/Project Manager/Technical Associate, Pollution Control Engineering, IT Corporation, Knoxville, Tennessee.** Responsible for technical direction, successful management and execution of various engineering projects involving hazardous waste management including incineration, energy recovery, and air pollution control. Major accomplishments include:

- Serving as process integrator responsible for all the technical aspects of the incinerator for the Bayou Bonfouca project. Developing an oxygen combustion system for the Bayou Bonfouca kiln to increase waste throughput after a detailed technical and economic evaluation. Directing the particulate carry-over from the kiln calculations which resulted in the decision to use superkiln instead of medium kiln. Providing technical direction and team member preparation of process flow diagrams (PFDs), P&IDs, equipment drawings, selection of hardware and the vendor supplying it. Wrote test plans and coordinated laboratory testing, technical coordination with the subcontractor and other IT offices. The combined total of capital equipment and engineering is approximately \$6.4 million.

- Providing technical direction and support to a \$60 million plus Oxychem remediation proposal effort. The task involved incineration of dioxin-contaminated soils from the Love Canal site at Niagara Falls, New York. Selecting the proper system configuration; estimated costs; and wrote the technical proposal. Providing similar support in the preparation of Times Beach Superfund proposal.
- Providing technical direction and support to a \$100 million plus Bayou Bonfouca Superfund remediation proposal effort and won the job primarily on technical merit. Selecting a proper size of the rotary kiln for the proposed incinerator; estimating costs; and preparing an incinerator part of the proposal that will serve as a model for future in-house proposal efforts.
- Preparing a detailed technical and commercial proposal for a package incinerator for Glaxo, Stevenage, U.K. The proposal effort included the preparation of PFDs, P&IDs, plot plan, foundation plan, and a detailed technical write-up.
- Managing and providing technical direction for evaluating LINDE'S Oxygen Burner System in HTTS[®]-1 Rotary Kiln at the Louisiana Army Ammunition Plant (LAAP). Preparing the detailed test plan for regulatory and IT management approval and preparing the final test report. As a result of this test, recommended a dual air burner system configuration for HTTS[®] kiln that processes lightly contaminated, high moisture soil. This concept was developed and engineered for other remediation projects such as Sikes, Bayou Bonfouca, and Times Beach. The project was completed on schedule, and \$40K under budget. Pollution Control Services (PCS) group nominated this project team for the IT National Quality Award.
- Managing, evaluating and recommending an appropriate dry air pollution control (APC) system for IT's HTTS[®] for the European and Domestic market. Also, prepared a detailed report including designs of hardware constituting the dry APC systems, European and domestic regulatory criteria, capital and operating cost of various systems and conclusions and recommendations. Prepared another document on available wet APC systems with the scope as stated above. These documents have become a valuable resource for the group.
- Preparing the conceptual design; performing the economic evaluations of various options; calculated air emissions; and providing detailed technical support for IT-Northumbrian and Saltend rotary kiln-based fixed facility hazardous waste incinerators to be located in England. At each of these locations, 110 MM BTU/hr. incinerator is proposed; however, the incinerator configuration is quite different.
- Managing and engineering quench/dry air pollution control system for the down-sized HTTS[®] incinerator and prepared the Toxic Substance Control Act (TSCA) permit application.

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- Assisting in the start-up of the first transportable, pyrolytic kiln processing organic-rich solids, sludges and liquids at the La Marque, Texas Superfund site. Optimized process conditions for the HTTS[®]-1 incinerator at LAAP.
 - Preparing detailed engineering design of kiln and ash handling areas of IT's HTTS-2.
 - Preparing preliminary process design and cost estimate for a fixed facility incinerator for Merck Sharp & Dohme de Puerto Rico, Inc.
 - Preparing preliminary design and cost estimate for solids feed system to the rotary kiln for Rohm and Haas and Vulcan Chemicals Company.
- 1985 - **Manager, Transportable Incinerators, Ensco Environmental Services, Inc., Franklin, Tennessee.** Duties included overall coordination between engineering department and operation of modular, transportable incinerator units for hazardous waste disposal. Major accomplishments included:
- Preparing transportable incinerator permit from the U.S. Environmental Protection Agency (EPA) meeting all EPA requirements to incinerate resource conservation and recovery act (RCRA) and TSCA wastes
 - Co-authoring permit application to EPA outlining the trial burn plan and unit specifications.
- 1985 - **Startup Engineer, Ensco Environmental Services, Inc., Sydney Mine Site, Tampa, Florida.** Responsible for the successful startup of a transportable incinerator to incinerate contaminated solids and liquids (total project revenue of \$1.2 million). Designed and started up a system to convert sludge to a pumpable waste.
- 1982 - **Project Engineer, Ensco Environmental Services, Inc., Tullahoma, Tennessee.** Responsible for the design and procurement of hardware to build a modular, transportable solid/liquid incineration system. Major accomplishments included:
- Performing economic analyses for equipment needs
 - Developing, designing, and starting up a waste heat recovery system for the unit, resulting in a \$500,000 savings in operating costs
 - Serving as co-consultant to IBM to recommend means for reduction of dioxin emissions from municipal waste incineration systems.
- 1981 - **Engineer III, Sverdrup Technology, Inc., Tullahoma, Tennessee.** Responsible for the design and start up of various process plants. Major responsibilities included:

- Preparing the final design, P&ID, shop drawings, and commissioning of a base metal oxide reduction unit
 - Preparing the preliminary design and cost estimate of a 300-gallon-per-hour PCB incineration unit
 - Preparing the preliminary design and cost estimate of a 40 million gallon-per-year anhydrous ethanol unit
 - Performing thermal analysis of a rocket diffuser.
- 1979 - **Graduate Research Assistant, University of Missouri, Rolla, Missouri.** Operated and modified a 2,000 pound-per-hour wood gasification unit. Also responsible for pilot-scale experiments in fluidized bed gasification unit using sawdust, wood chips, and lignite. Designed and built an adsorption system to decontaminate scrubber effluents from the plant. Responsible for the design of a CO₂ removal system. Was the Chairman of the Safety Committee for the project.
- 1977 - **Process Development Engineer, International Fertilizer Development Center, Muscle Shoals, Alabama.** Designed, operated, and maintained pilot plants producing nitrogen phosphorous potassium (NPK) fertilizers and phosphoric acid. Developed urea supergranules and new NPK mixtures and performed research and development on a bench-scale/pilot-scale wet phosphoric acid unit.

Awards

- Delegate, 20-Member American Institute of Chemical Engineers delegation to China; 1993
- Who's Who Among Young American Professionals, 1992
- IT Quality Award-3rd Quarter (1992)
- IT Technical Associate, 1992
- IT National Quality Award Nomination - Oxygen Burner Test Project Team, 1990

Professional Affiliations

American Institute of Chemical Engineers
Institute of Hazardous Materials Management

Publications/Presentations

Acharya, P., and Shafer, L., 1993, "How to Select an Oxygen-based Combustion System for Rotary Kiln based Hazardous Waste Incinerators," to be presented at the *1994 Incineration Conference*, Houston, Texas.

Acharya, P., and Prabhu, S., 1993, "Estimation Methodology and Validation of Particulate Entrainment in a Rotary Kiln based Hazardous Waste Incinerator," to be presented at the *1994 Incineration Conference*, Houston, Texas.

Acharya, P., Pakrasi, A., Davis, W., 1993, "Removal of Sulfer Dioxide from the Gas of Incineration Facilities by Dry Air Pollution Control Systems: Theory and Practice," to be presented at the *Air and Waste Management Association's 87th Annual Meeting (1994)*, Cincinnati, Ohio.

Acharya, P., and Peter Ives, 1993, "Incineration at the Bayou Bonfouca Remediation Project," to be published in *Waste Management*, December, 1993.

Acharya, P., and Peter Ives, 1993, "Overview of Bayou Bonfouca Remediation Project," presented at the *1993 IT Technology Exchange Symposium*, Scottsdale, Arizona.

Acharya, P., Kirslis, and Prabhu, S., "Innovative Method for Sizing a Plume Suppression System for Hazardous Waste Incinerators," to be published in *Chemical Engineering Progress*, January, 1994.

Acharya, P., Kirslis, S., and Sachin Prabhu, 1993, "Innovative Method for Sizing a Plume Suppression System for Hazardous Waste Incinerators," presented at the *86th Annual Meeting of the Air and Waste Management Association*, Denver, Colorado.

Acharya, P., and S. G. DeCicco, 1992, "Energy Recovery Boiler Technology for Hazardous Waste Incinerators," Presented at the *1992 Incineration Conference*, Albuquerque, New Mexico.

Acharya, P., S. G. DeCicco, and R. Novak, December 1991, "Factors That Can Influence and Control the Emissions of Dioxins and Furans from Hazardous Waste Incinerators," *Journal of the Air and Waste Management*, Vol. 41, No. 12.

Acharya, P. and K. Mak, 1991, "Heat Transfer in a Countercurrent Rotary Kiln," Presented at the *1991 Incineration Conference*, Knoxville, Tennessee.

Acharya, P., S. G. DeCicco, and R. Novak, 1991, "Factors That Can Influence and Control the Emissions of Dioxins and Furans from Hazardous Waste Incinerators," Presented at the *84th Annual Meeting of the Air and Waste Management Association*, Vancouver, Canada.

Acharya, P. and R. G. Novak, May 1991, "The Evaluation of Supplemental Oxygen Burner Firing in a Countercurrent Rotary Kiln," *Environmental Progress*, Vol. 10, No. 2.

Acharya, P. and R. G. Novak, 1990, "The Evaluation of Supplemental Oxygen Burner Firing in a Countercurrent Rotary Kiln," Presented at the *1990 American Institute of Chemical Engineers Summer National Meeting*, San Diego, California.

Acharya, P., 1987, "PCB Trial Burn in a Modular, Movable Incinerator," Presented at the *2nd International Conference on New Frontiers of Hazardous Waste Management*, Pittsburgh, Pennsylvania.

Acharya, P., 1987, "PCB Trial Burn in a Modular, Movable Incinerator," Presented at the *1987 Air Pollution Control Association Meeting*, New York, New York.

Acharya, P., 1985, "Operation of a Modular, Transportable Waste Incinerator on a Site," Presented at the *1985 International Conference on Combustion Systems and Hazardous Waste Incineration*, San Francisco, California.

Acharya, P., 1984, "Incineration of Hazardous Waste in a Mobile System," Presented at the *1984 International Conference on Alternative Fuels and Hazardous Waste Incineration*, Tulsa, Oklahoma.

Acharya, P. and G. Combs, 1983, "Dioxins Emissions on Municipal Waste Incinerators," *report submitted to IBM Corporation*.

Acharya, P., 1980, "Wood Gasification Waste Water Treatment Using Activated Carbon," *M.S. Thesis*, University of Missouri, Rolla, Missouri.



WEC/US-AEP

Environmental Business Exchange (EBE) Trip Reports

February 22, 1995

Trip Reports as per Cooperative Agreement (CA) AEP-0015-A-00-2055-00 in Support of the U.S.-Asia Environmental Partnership

<u>EBE ID#</u>	<u>EBE DATES</u>	<u>TITLE OF TRIP REPORT</u>
INDI-1I	11/7-23/93	Oil Absorbent Demonstration
INDI-1K	12/6-29/93	Review of Incinerator Operations, Indian Thermal and Cyno Clean
INDI-2	4/23 - 5/6/94	Review of Pollution Prevention Control Technology in the Textile Industry
INDI-5	4/30 - 5/10/94	Clean Coal Technology Evaluation
INDI-1P (1&2)	5/94-8/94	Clean Technology for Paper Mills - Esvin - Parts 1&2
INDI-1R	6/18-30/94	Evaluation of Biological Formulations for Industrial Wastestreams Treatment (Premier Ziba)
INDI-1Q	6/18-7/1/94	Indian Boilers Manufacturers' Association Trade Mission
PHIL-8	9/27-10/6/94	Technical Assistance on H ₂ S Gas Abatement Systems (PNOC)
HONG-1	10/23-11/9/94	Coleman Energy and Environmental Systems Technology Transfer
KORE-1	12/9-22/93	Fuel Gas Desulfurization Technology Assessment (KEPCO)
INDI-1L	1/17-2/23/94	Corporate Environmental Mission (IT Corporation Exchange)
INDI-4	3/11-30/94	Evaluation of CS ₂ Recovery in Rayon Mills