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ISA 88513

FLUIDIZED BED CHEMICAL RECOVERY SYSTEM

India

November 13 - November 26, 1993

Prepared for:

US - ASIA ENVIRONMENTAL PARTNERSHIP



WORLD ENVIRONMENT CENTER

DISCLAIMER

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I. EXECUTIVE SUMMARY

On November 13 through November 26, 1993, Mr. Joseph T. Enders, President, Enders Process Equipment Corporation, traveled to India under the auspices of the U.S.-Asia Environmental Partnership (US-AEP) Environmental Business Exchange (EBE) program, through a Cooperative Agreement with WEC. Mr. Enders trip focused on the following purposes:

- 1) To help our new Licensee, Agro Pulping Machinery Pvt Ltd. close the sale for our first demonstration plant in India.
- 2) To help introduce our Fluid Bed Pollution Control Processes;
 - to the municipal and industrial markets in India (Pollution free incineration of waste sludge), and
 - to the pulp and paper industry market in India (Pollution free recovery and reuse of chemicals)
- 3) To finalize and execute our negotiated Licensee Agreement.

Enders Process Equipment Corporation produces a Fluid Bed Recovery System which provides for the treatment of spent pulping liquors in a fluidized bed reactor for the purpose of recovering the pulping chemicals and simultaneous completion and pollution free destruction of the unwanted organic pulping residue by thermal oxidation. The chemicals, recovered as pelletized salt cake, can be sold or recycled.

As a result of this exchange, it was concluded that there is a need for India's pulp and paper mills to adopt a system that does provide for the recovery of spent pulping liquors and chemicals for their reuse. Although there was a great interest in Enders Fluid Bed Recovery System, pulp and paper mills are interested in seeing the success of this system demonstrated first along with trial runs of their particular liquors.

Currently, Shreyans Paper Mills Ltd. is working towards the construction of an Enders Fluid Bed Recovery System for themselves.

In addition, Agro Pulping Machinery Pvt. Ltd. is proposing to construct a pilot system which could be used for trial runs on liquor from various pulp mills and would give each potential client assurance that the process they purchase will successfully process their particular black liquor and recover chemicals for their reuse.

II. INTRODUCTION

Enders Process Equipment Corporation has experience, expertise and know-how in the design, application and support of fluidized bed reactors, dryers, and coolers as well as related process equipment. India is currently in the throes of a major environmental pollution crisis, creating a great demand for new pollution control technology. Therefore, Mr. Enders believes that the Indian municipal and industrial (particularly the pulp and paper industry) markets would benefit from the introduction of fluid bed pollution control processes.

For example, the Indian paper industry has 325 pulp and paper mills, large and small. The large mills have installed very expensive "conventional chemical recovery" while the small mills, which supply one third of the country's paper, but cannot afford conventional chemical recovery. Even if cost were not an issue for some of the small mills, the efficiency of this process is very poor when it is used on the small amount of chemicals discharged by the typical small mill. These mills have thus resorted to discharging their chemical waste on the ground or dumping it in the sea. These small mills contribute three times the amount of land pollution than is generated by the larger mills. The process offered by Enders Process Equipment Corporation costs about half as much as the conventional chemical recovery process, and is efficient at any flow rate.

As a result of an initial trip to India where a presentation covering Enders Fluid Bed Recovery System was given to Indian paper mill representatives, interest in this system was generated and various paper mills in India requested a follow-up visit for a more in depth introduction of the fluid bed chemical recovery system. In addition, through further discussion, Enders Process Equipment Corporation has entered into an agreement with Agro Pulping Machinery Pvt. Ltd. to manufacture their Fluid Bed Recovery System in India. Shreyans Paper Mills Limited has entered into an agreement with Enders Process Equipment Corporation and Agro Pulping Machinery Pvt. Ltd. to construct a fluid bed chemical recovery system for their own facilities.

The purpose of Mr. Enders' visit to India was to close the Shreyans Industries Ltd. sale, to help promote use of the fluidized bed technology in India and to finalize the License agreement for India with Agro Pulping Machinery Pvt. Ltd.

Mr. Enders exchange was funded under the US-AEP EBE program through a cooperative agreement with WEC.

III. DISCUSSIONS AND FINDINGS

A. Introduction

During the course of this trip, Mr. Enders attended meetings with potential clients, Enders Process Equipment Corporation's licensee in Madras (Agro Pulping Machinery Pvt. Ltd.), and Shreyans Industries Ltd. In addition, he surveyed plants of a few potential clients to suggest how the chemical recovery system would meet the needs of their plants. Mr. Enders found that each of these mills have a very severe pollution problem because most have been operating for years without the any water pollution control. Now the government of India is requiring these established mills to comply with environmental standards, even if it means that the mill must close. For this reason, all of the mills visited have a very high interest in Enders Process Equipment Corporation's technology. However, most are delaying their decision to recover chemicals for as long as they possibly can. The following is a brief description of each formal meeting held in India.

B. Visit to M/s. Shreyans Industries Ltd., Ludhiana (Nov. 15):

Contacts: ANIL KUMAR: Executive Director
B.D. SHARMA: Dy. General Manager
D.K. OSWAL

There was a general discussion between Agro-Enders and Shreyans regarding the proposal submitted for Fluidized Bed Soda Recovery System. The results of this meeting are as follows:

1. It was pointed out that about 10-12 TPH of steam at 3.5 Kg/sq.cm. pressure will be required for concentrating the black liquor. Shreyans agreed to put up 1 No. FBC Boiler for this purpose. The cost was budgeted at Rupees (Rs.) 100 lakhs.
2. Regarding guarantees, Mr. Enders pointed out that Indian mills use different types of raw materials and the cooking conditions are not the same as for materials used in the U.S. He would like to have liquor tested at the pilot plant at Hazen Corporation in Colorado, U.S.A. This was agreed to in principle, and Shreyans will bear the cost for testing of the liquor in the U.S.A. Shreyans also agreed to send liquor at 30 percent dissolved solids (DS) in sufficient quantity to conduct a three-day trial.
3. While Shreyans generally accepted the budgeted cost given by Agro, there was a discussion with Shreyans' Chairman about a payment for the Engineering Services to be provided by Enders. Shreyans has agreed to make a payment of USD200,000 on agreed terms. Payment will be made in five (5) or six (6) installments, progressively, and Mr. Enders agreed to a retention amount of 7.5 percent of the above value to be retained for a period of six (6) months after completion of the commissioning.

4. It was noted that it is possible to complete the entire job before December 1994, provided the order is placed by January 1994.

C. Visit to M/s. Mukerian Paper Mills, Punjab. (Nov. 16)

Contacts: H.R. Darwesh: Executive Director
Neelam Kumar Oswal

Mr. Joseph T. Enders met with Mr. Neelam Oswal of M/s. Mukerian Paper Mills, Punjab. They discussed the problem related to black liquor burning, and it was agreed that they will draft a statement of their requirements for chemical recovery and will also inform Agro of the possibility of installation of a Soda Recovery System. They indicated that they will be going for such a system around the end of 1994.

D. Visit to M/s. Agro Boards Ltd., Chandigarh. (Nov. 17)

Contact: Lovely Singh: Managing Director

Mr. Enders and representatives from Agro Pulping Machinery visited M/s. Agro Boards Ltd., Ropar District, Punjab. This is a mill which is expanding from 25 TPD to 70 TPD paper production. At the end of the meeting, Agro Boards Ltd.'s Managing Director, Mr. Lovely Singh, decided that Agro Boards Ltd.'s representatives will accompany the Agro Pulping Machinery people on a visit to a mill in South Africa, and then decide whether to have a recovery system installed. In any case, Agro Boards Ltd. will definitely go for an installation of a recovery system by the middle of 1994 if financing is available from the government.

E. Visit to M/s. Grasim Industries Ltd., Calicut (Nov. 20)

Contacts: R.N. Saboo: Senior Executive President
C. Kochukrishnan: Joint Executive President
G.L. Gattani: Joint Works Manager

Mr. Enders and Agro Pulping Machinery representatives visited M/s. Grasim Industries Ltd., in connection with Agro-Enders proposal for evaporator retrofit for an overall upgrade of their existing system, including higher steam economy, evaporation rate, and discharge concentration. Grasim expressed their concern about achievement of the proposed improvements in the absence of a test of their own liquor. Agro-Enders proposed converting Grasim's existing small horizontal tube evaporator to a test unit which will provide the assurance that the Grasim liquor can be concentrated to 63 percent DS without excessive scaling. Grasim agreed to this plan and requested that Agro-Enders offer a new proposal, including a test run and retrofit. The retrofitting will be done if the test run results are as stipulated: otherwise, Agro

will return the total amount of money which Grasim advanced.

F. Visit to M/s. Soma Papers & Industries Ltd. Bombay (Nov. 22)

Contacts: K.K. Somani: Chairman & Managing Director

Mr. Enders and the people from Agro Pulping Machinery met Mr. K.K. Somani, Managing Director and Chairman of M/s. Soma Papers & Industries Limited. Mr. Somani expressed concern about silica in agricultural residue black liquor for processing in the Soda Recovery System. Mr. Enders assured him that, in his proposed system, the problem of silica is much reduced due to the following:

1. Black liquor will be concentrated to 30 or 35 percent only in a Multiple Effect Evaporator.
2. The temperature of combustion is not more than 1350°F which will not allow silica to fuse.
3. The subsequent sedimentation in the causticizing process will reduce the silica.
4. The silica concentration will not build up due to purging.

Mr. Somani requested a proposal to convert calcium sulfate to its hemihydrate. Mr. Enders pointed out that conversion of calcium sulfate to the hemihydrate was to be carried out at substantially low temperature. Mr. Enders asked Mr. Somani for, and was provided, particle-size distribution. He found it to contain 97 percent less than 45 microns. Mr. Enders assured Mr. Somani that Enders Process Equipment Corporation would prepare a proposal in the near future.

Mr. Somani also requested a proposal for lime calcination. Mr. Enders agreed to provide a proposal covering a three (3) stage reactor; he also indicated the facilities where they are currently in use.

G. Meeting with ICICI, Bombay. (Nov. 23)

Contacts: A.J. Advani: General Manager
K. Harinathan: Manager
Girish R. Mahajan

The Industrial Credit & Investment Corporation of India (ICICI), the sponsors of the TEST program under USAID, met with Agro-Enders & Shreyans, Punjab. The technology was reviewed in length by ICICI to support the financial scheme which is to be implemented at Shreyans. ICICI asked Agro-Enders to provide all the assistance needed to prepare the project cost. Mr. Advani, General Manager in charge of the TEST program, also reviewed the proposal and, in principle, gave verbal consent to go ahead with the project.

H. Meeting with Agro Pulping Machinery Pvt Ltd., Madras (Nov. 24)

Contacts: S. Raghavan: Managing Director
N. Swaminathan: Director
S. Das Gupta: Project Manager

Mr. Enders and the technical personnel of Agro Pulping Machinery discussed various methods of promoting the Fluid Bed Soda Recovery System in India. They also discussed a collaborative agreement for manufacture of the Soda Recovery System and Evaporator. This agreement was finalized and signed by both parties. In addition, Mr Enders discussed various methods of improving the marketing program, visits by technical persons from India to U.S.A., and potential visits to a South African paper mill in which the process is employed.

This meeting came to a conclusion with a happy note; both parties will review the pollution problem in this country and take such steps as are needed to help the industry with new technology and expertise from the U.S.

I. Meeting with Kankariya Paper Mills at Madras (Nov. 24)

Contacts: R.S. Bapna: Chief Executive

Mr. Enders met with R.S. Bapna, Chief Executive, Kankariya Paper Mills, at Agro Pulping Machinery's offices. He was a very interested potential client. In this meeting, Mr. Enders explained in detail the fluidized bed chemical recovery process and answered general questions put forward by Mr. Bapna.

IV. CONCLUSIONS AND RECOMMENDATIONS

Since black liquor is a by-product of all pulp mills and contains spent cooking chemicals, and since small pulp mills in India do not recover these chemicals, there is no question that, in order to operate their plants, they pollute the waters or land. Mr. Enders' recommendation is that each of the mills mentioned above, as well as other similar facilities, install a fluidized bed chemical recovery system to reuse spent cooking chemicals instead of dumping these chemicals into the environment. In addition, I have found that potential pulp and paper industry clients, although very interested in the technology we offer, want to wait until the demonstration plant is shown to operate successfully. This is due to the fact that, unlike pulp mills in other countries, Indian pulp mills use agro based raw materials. Although the process works for raw materials such as wood and bagasse in other countries, it isn't proven for raw materials used in India, such as grass and straw.

Mr. Enders would recommend that USAID provide financial assistance to Agro Pulping Machinery Pvt Ltd., which wants to erect and operate a small chemical recovery pilot plant to make trial runs on each pulp mill's black liquor, considering the process. This would quickly promote the process. More importantly, since the variety of raw materials used varies greatly among Indian pulp mills, it would give each potential client assurance that the process he purchases will successfully process his particular black liquor and recover chemicals for his reuse.

Conclusion 1: Shreyans Industries Ltd., will apply for a grant under the TEST program.

Shreyans Industries Ltd., a client of Agro Pulping Machinery Pvt. Ltd., will apply to ICICI for a "grant" under the TEST program. Once approved, they will install demonstration chemical recovery plant in India. March 2, 1994 communication from received from Shreyans suggest that this project will start on April 1, 1994.

Conclusion 2: A high interest in the Fluidized Bed Chemical Recovery Process exists among Indian pulp and paper firms.

The cooking process used through out India is the "soda" process which allows chemical pellets recovered from the fluid bed process to be reused in the cooking process to provide a good payout period. A great deal of interest in this system has been expressed by Indian pulp and paper manufacturers.

Recommendation 1: Financial assistance is needed to construct and operate a small chemical recovery pilot plant to make individual trial runs on plant specific processes.

Mr. Enders has found that potential pulp and paper industry clients, although very interested in the technology we offer, want to wait until the demonstration plant operates successfully. He recommends that USAID provide financial assistance to Agro Pulping Machinery Pvt Ltd. to construct and operate a small chemical recovery pilot plant to make trial runs on individual pulp mill's black liquor.

Recommendation 2: It appears that Shreyans Industries Ltd. will utilize the chemical recovery process if funding is made available.

Mr. Enders is convinced that Shreyans Industries Ltd. will erect a chemical recovery process once they receive approval of their application for financial aid from the ICICI, and that it will be a successful project.

V. COST AND PAYBACK INFORMATION

Shreyans Industries Limited will be installing a chemical recovery system with a reactor bed diameter of 12'-0".

Since it is Agro Pulping Machinery Pvt Ltd.'s function to develop equipment cost figures in India, as well as the variable cost of the chemicals recovered, Enders Process Equipment Corporation does not have cost figures on the initial cost, or the amount of cost reduction as a result of reusing the chemicals recovered. However, at the meeting with ICICI personnel, Shreyans stated the payout period would be less than six (6) years (see visit G. on Nov 23 as reported above). Agro Pulping Machinery Pvt Ltd.'s estimates that the equipment they supply will cost approximately USD1,000,000 with Shreyans supplying the rest of the equipment. Mr. Enders expects the entire plant would cost approximately USD3,000,000.

VI. IMPLEMENTATION PLAN AND SCHEDULE:

Actual installation of a fluidized bed chemical recovery plant will require 12 to 18 months from the date of the purchase order to start-up (which itself takes 2 weeks). The client should plan to have a Liaison Engineer on site for 4 to 6 months.

APPENDIX A
PERSONS AND ORGANIZATIONS VISITED

PERSONS AND ORGANIZATIONS VISITED

1. Shreyans Industries Ltd., Ludhiana (Nov. 15):

Contacts: ANIL KUMAR: Executive Director
B.D. SHARMA: Dy. General Manager
D.K. OSWAL

2. Mukerian Paper Mills, Punjab. (Nov. 16)

Contacts: H.R. Darwesh: Executive Director
Neelam Kumar Oswal

3. Agro Boards Ltd., Chandigarh. (Nov. 17)

Contact: Lovely Singh: Managing Director

4. Grasim Industries Ltd., Calicut (Nov. 20)

Contacts: R.N. Saboo: Senior Executive President
C. Kochukrishnan: Joint Executive President
G.L. Gattani: Joint Works Manager

5. Soma Papers & Industries Ltd. Bombay (Nov. 22)

Contacts: K.K. Somani: Chairman & Managing Director

6. Industrial Credit & Investment Corporation of India (ICICI), Bombay. (Nov. 23)

Contacts: A.J. Advani: General Manager
K. Harinathan: Manager
Girish R. Mahajan

7. Agro Pulping Machinery Pvt Ltd., Madras (Nov. 24)

Contacts: S. Raghavan: Managing Director
N. Swaminathan: Director
S. Das Gupta: Project Manager

APPENDIX B
BUSINESS CARDS OF PEOPLE CONTACTED

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B.D. Sharma
Dy. General Manager

G.I. Gattani
Jt. Works Manager

Phones: Off: (0495) 356721, 355722
356723, 356724, 355725, 356726
Fax: 049428 - 311E
Tlx: 0804-242
Grams: WOOD PULP

11/20/93

SHREYANS INDUSTRIES LIMITED
UNIT : SHREYANS PAPERS

Works : Malikpur, Ahmedgarh-148021,
Distt. Sangrur (Punjab), Gram: SHREYANS
Phones : 01673-40347, 40348, 40349 Fax : 01673-40512



GRASIM INDUSTRIES LIMITED
PULP DIVISION
MAVOOR - 673 661, Calicut, Kerala, India



11/23/93

K K SOMANI
Chairman & Managing Director

11/23/93

GIRISH R. MAHAJAN



Indian Mercantile Chambers, 3rd Floor, 14 R. Kamani Marg, Ballard Estate, Bombay 400 038
Tel: (22) 261 9211, Tlx: (11) 84493, Fax: 91 22 261 7288

T.E.S.T. PROGRAMME

THE INDUSTRIAL CREDIT & INVESTMENT CORPORATION OF INDIA LTD.
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Phone: 2618251 Grams: 'Credcorp' Bombay Teler: 011-84458 ICIC IN
Telefax: 262 5444

ICICI

Res. 2150043



11/23/93

A.J. ADVANI

BE (Chem), DBM, Development
Bank Management (West Germany)

K. HARINATHAN
MANAGER

GENERAL MANAGER

INDUSTRIAL CREDIT & INVESTMENT CORPORATION OF INDIA LIMITED
Scindia House, N. M. Marg, Ballard Estate, Bombay 400 038
Ph: 2618251, Tlx.: 011-84458 ICIC IN, Fax: 2625444
Gram: "Credcorp" Bombay

T.E.S.T. GROUP

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SCINDIA HOUSE, N. M. MARG BALLARD ESTATE, BOMBAY-400 038 - 50
Phone: 2610251 Grams: 'Credcorp' Bombay Teler: 011-84458 ICIC IN
Telefax: 262 5444



11/16/93

ANIL KUMAR
Executive Director

SHREYANS INDUSTRIES LIMITED

Works : Malikpur, Ahmedgarh-148021,
Distt. Sangrur (Punjab), Gram: SHREYANS
Phones : 01673-40347, 40348, 40349 Fax : 01673-40512



11/27/93

R. S. BAPNA

B. Tech (Chemical (Engg.))
Chief Executive

KANKARIYA PAPER MILLS

(A DIV. OF
KANKARIYA CHEMICAL IND. LTD.)
B. N. CHAMBERS
R. C. DUTT ROAD,
BANGODA-390 005,
PHONE : 325297, 377947
FAX : 336146
GRAM : KANKARIYA

BEST AVAILABLE COPY

Neelam Kumar Oswal



Ludhiana : Tel. Off. 670198,670199 Fax : 0161-672197PWC
672434,672435 0161-672436 MPL
Delhi : D.C.M.Bldg.3755199,3719133 Fax : 011-2755169
3715959
Bombay : Tel. Off. : 2874847,243385 Fax : 022-2022732
Bangalore : Tel. Off. : 568228 Extn. 1108

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Mukerian Papers Ltd., Mukerian.
Oswal Sugars Ltd., Mukerian.
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Oswal Foods Ltd., Khalilabad.
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- * Bharat Udyog Award (New Delhi)
- * Karnataka Udyog Award (Bangalore)
- * Bio-Data Published in
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H. R. Darwesh

Regd. Office
Dhandari Kalan, G.T. Road,
LUDHIANA 141 310
Phones : 672196, 672434, 672435, 672199
Grams : COMBERS
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☎ (Off.) 670317 (RES.) 33771, 50001

☎ 386-287 ATL IN ☎ 0161-670315

4E, GOPALA TOWER, 25, RAJENDRA PLACE
NEW DELHI-110008

☎ 5721042, 5732104 ☎ 031-77140 SPML IN
☎ 91-11-5752271

302, RAHEJA CHAMBERS, NARIMAN POINT
BOMBAY-400021

☎ 2851708, 2851025 ☎ 011-84213 SPML IN ☎ 242825

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**APPENDIX C
CURRICULUM VITAE**

Joseph T. Enders, P.E.
Post Office Box 308
Glen Ellyn, Illinois 60137
Tel: (708) 469-3787
Fax: (708) 469-3793

Education: University of Wisconsin, Madison (1963)
M.S. Chemical Engineering

Experience: **Enders Process Equipment Corporation**
President

- Design and erection of fluidized bed reactors for spent pulping liquors
- Servicing of Copeland Systems Inc. accounts
- Design, construction, and start-up of multi-effect evaporators and fume incinerators, both thermal and catalytic

Copeland Systems Inc.
Senior Project Manager

- Process design and calculations, equipment design, equipment installation, and negotiating plant acceptance with client
- Complete coordination from design to start-up of eleven Municipal Sewage Sludge Incineration and Paper Mill Chemical Recovery plants

Struther's Wells Corporation

- Coordinated project for incineration of hazardous liquid waste by use of fluidized bed incinerators including design, installation and start-up of pilot plant, conduct pilot study, and issue report to Government
- Design of fluidized bed dryers and coolers

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