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CLRI/UNIDO/002/14

196 p.
tables
graphs
diagrams
illus.

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES

(UNIDO PROJECT : US/IND/90/244/2)

TERMINAL REPORT

PART - A

AMMONIA FREE AND CLEANER WET TANNING OPEARTIONS

A PROJECT ASSIGNED BY

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

IMPLEMENTED BY

CENTRAL LEATHER RESEARCH INSTITUTE

(Council of Scientific & Industrial Research)

ADYAR, MADRAS - 600 020, INDIA

FEBRUARY, 1996

R

PART -A

AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS

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CONTENTS

1. INTRODUCTION
2. PROJECT PROFILE
   - 2.1 Technical Description
   - 2.2 User Agency Profile
   - 2.3 User Agency - CLRI Contract
3. PROCESS TECHNOLOGY
4. PLANT AND EQUIPMENTS
5. PROJECT ENGINEERING ASPECTS
   - 5.1 Turnkey Sub Contracts
   - 5.2 Time Schedule And Important Activities
   - 5.3 Dry & Wet Runs
   - 5.4 Commercial Scale Trials
   - 5.5 Programme Review By Experts
   - 5.6 Photographic Views of Tejoomal's Tannery
6. TRAINING OF PERSONNEL
7. PROCESS DEMONSTRATION REPORT
8. TECHNOECONOMIC VIABILITY OF PROJECT
9. RECOMMENDATIONS

ANNEXURES

- I PROCESS RECEIPE
- II PROCESS FLOW SHEETS
- III.1 EQUIPMENT SPECIFICATION
- III.2 INSTRUMENT SPECIFICATION
- III.3 ELECTRICAL WIRING DETAILS
- III.4 CONTROL ROOM DETAILS
- III.5 PLATFORM & DRAINAGE DETAILS
- IV TENDER DOCUMENT
- V REPORTS OF VISITING EXPERTS

1. INTRODUCTION

1. Introduction

There are approximately 1000-1200 tanneries in India, mostly in small and medium-scale sectors, concentrated predominantly in three regions, viz. Tamil Nadu, West Bengal (Calcutta) and Uttar Pradesh (Kanpur). The State of Tamil Nadu leads with 60 per cent of the installed capacity, followed by Calcutta with 20 per cent and Kanpur and the North Eastern region with 15 per cent, while the rest is scattered all over India.

In view of its economic importance, the leather and leather products sector, accounting for one of the top five foreign exchange earners of the country, has been identified by the Government of India as a priority development sector. A number of promotional measures have been announced in order to meet this objective. However, the present environmental pollution stemming from the tanning industries is threatening to halt the envisaged progress, unless it is tackled immediately and effectively. At present, only a few large-scale tanneries have set up their own effluent treatment plants and even these units have difficulties to meet the national effluent discharge standards.

One of the very important aspect to tackle this problem is the reduction of pollution at the source, i.e. the replacement of traditional technologies, producing considerable amounts of available wastes with cleaner processing methods.

The United Nations Industrial Development Organization (UNIDO) in cooperation with Central Leather Research Institute (CLRI) had launched a complex programme of implementation of environmentally cleaner technologies in selected tanneries to demonstrate the potential of available cleaner technologies.

2. Contractual Obligations

UNIDO awarded the sub-contact (92/107) of the project US/IND/90-244/2 to the Central Leather Research Institute (CLRI) to function as consultant for **"Implementation of Environmentally Cleaner Technologies"** in select Indian tanneries which could

of Environmentally Cleaner Technologies" in select Indian tanneries which could function as demonstration centers. In consultation with UNIDO, the following technologies have been chosen for implementation:

i. Ammonia free and cleaner wet tanning operations
ii. Chrome recovery and reuse
iii. Mechanical desalting
iv. Sulfide reduced liming

CLRI formed a special task force for implementation of the above projects. The task force members along with Chief Technical Adviser of UNIDO visited several tanneries to assess their suitability for setting up the above demonstration facilities. The selection of the tanneries were based on the following criteria:

i. Technical competence to absorb the technology
ii. Willingness to demonstrate the implemented system to other tanners
iii. Willingness to financially participate in the project to absorb part of the project cost

After scrutiny of various places, it was decided by the search team to set up the cleaner technology demonstration centers at the following places:

i. Ammonia free and cleaner wet tanning operations at M/s Tejoomal Industries Limited, Pernambut, North Arcot District, Tamil Nadu.
ii. Chrome recovery and reuse at M/s Arafath Tanneries, Chrompet, Madras.
iii. Mechanical desalting at M/s General Industrial Leathers, Chrompet, Madras.
iv. Sulfide reduced liming at M/s Haarty Union, Chrompet, Madras.

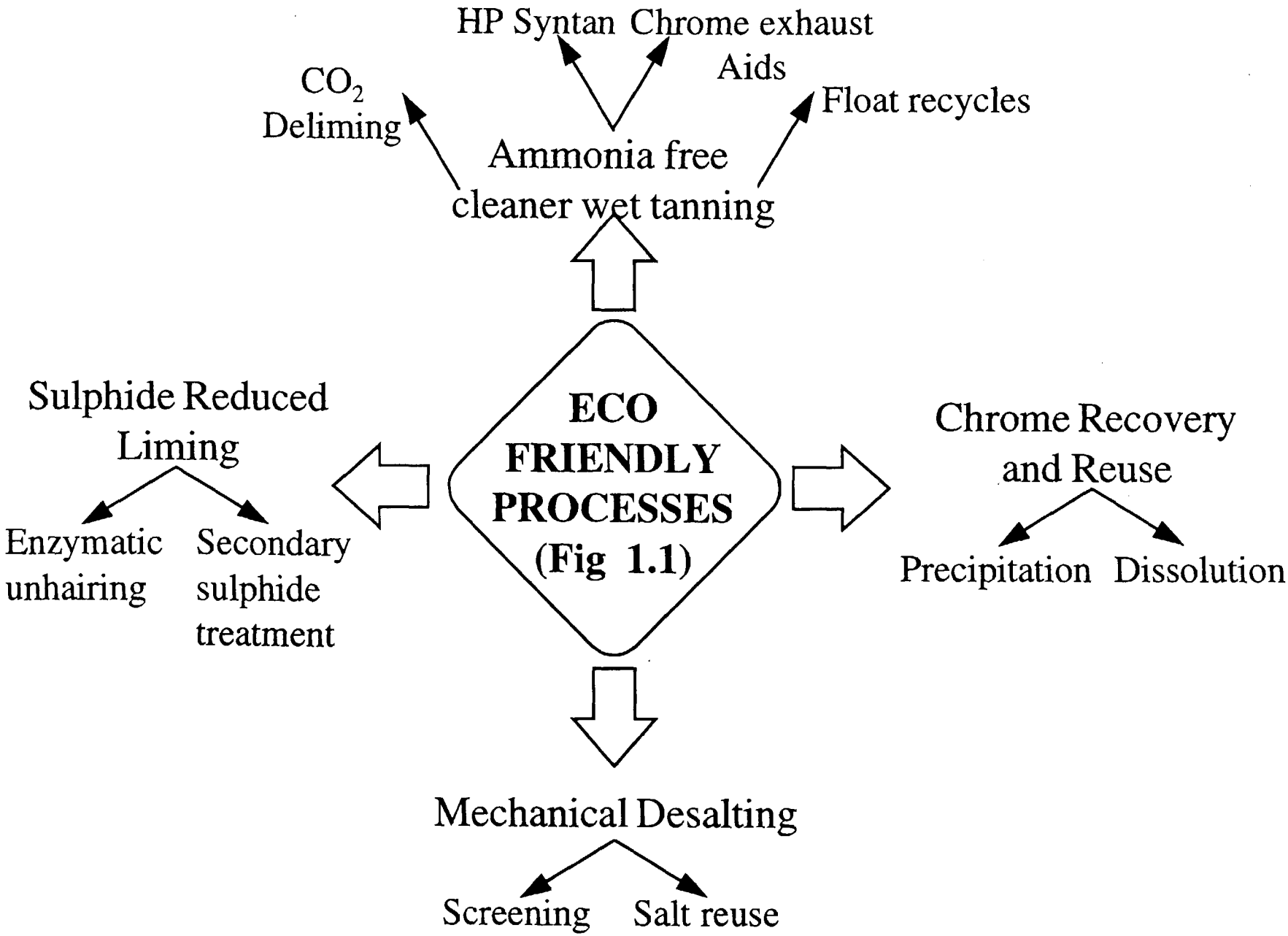
The basic features of the above projects are schematically represented in **Fig. 1.1** CLRI submitted Flash Report-1 in December 1992 to UNIDO highlighting the profiles of the above projects after the first level assessment of technical and financial aspects. Based

Fixed Price Proposal as Amendment-A to the sub-contract 92/107 for undertaking turnkey responsibility for the above programs. Based on which, UNIDO awarded sub-contract-2 of the Project US/IND/90/244/2 to CLRI for undertaking implementation of cleaner technologies of the selected tanneries.

The major activities involved in this assignment and executed by the task force are as below:

- Execution of agreement with user tanneries.
- Preparation of basic/detailed engineering
- Equipment procurement.
- Selection of appropriate sub contractors for sub tasks.
- Technical expertise and supervision during erection of equipment.
- Testing, trial running and commissioning of the project.
- Training of user tannery personnel.
- Techno-economic evaluation of the implemented technologies.
- Preparation of completion report.

This report gives details of the project on Ammonia free and cleaner wet tannery operations.


HP Syntan
Chrome exhaust Aids
CO_2 Deliming
Float recycles
Ammonia free cleaner wet tanning
Sulphide Reduced Liming
Enzymatic unhairing
Secondary sulphide treatment
ECO FRIENDLY PROCESSES (Fig 1.1)
Chrome Recovery and Reuse
Precipitation
Dissolution
Mechanical Desalting
Screening
Salt reuse

2. PROJECT PROFILE

2.1 TECHNICAL DESCRIPTION

2.1 Brief Description of the Project

For the sustained growth and development of Indian leather industry, implementation of cleaner production technologies is essential. Realising this need, CLRI through the financial support from UNIDO has implemented the environmentally friendly technology to minimize ammonia and other toxic chemical load in the tannery waste waters. This technology aims at in-process control of pollutants through improved processing techniques and deployment of environmentally cleaner chemicals.

A commercial scale demonstration facility of the above process has been set up at M/s.Tejoomals Ltd., tannery at Pernambut, North Arcot Ambedkar District, Tamil Nadu. Implementation of this project has enabled CLRI/UNIDO to demonstrate the techno-economic potential of this environmentally friendly option to various other tanneries in the area and to achieve multiplier effect therefrom. This project has also attracted financial participation by the host of user tannery to achieve closer involvement in the technology absorption.

The CLRI project team in consultation with the Chief Technical Adviser of UNIDO selected M/s.Tejoomals, Tannery at Pernambut as the host tannery for the absorption and demonstration of the above technology. A bilateral agreement was entered into between CLRI and the host tannery for the implementation of this project activity.

2.2 Basic Objectives of the Project

i) to reduce ammonia, chromium and other toxic chemical/biological load in the tannery waste waters through the improved in-process measures and implementation of cleaner technologies.

ii) to achieve better water management through water input control and float recycles.

iii) to minimize the rejects of finished leather and batch to batch variation of its quality through improved in-process control measures.

iv) to create better working environment and improved house keeping in tannery wet section.

v) to provide adequate protective measures to the tannery personnel to minimize occupational health hazards of chemical handling and process techniques and

vi) to provide on-job training to the host tannery personnel in the operation and maintenance of the add-on facilities.

2.3 Nature of the Technologies to be Employed

To achieve the objectives stated above, following technologies and engineering options have been implemented (See **Fig.2.1**).

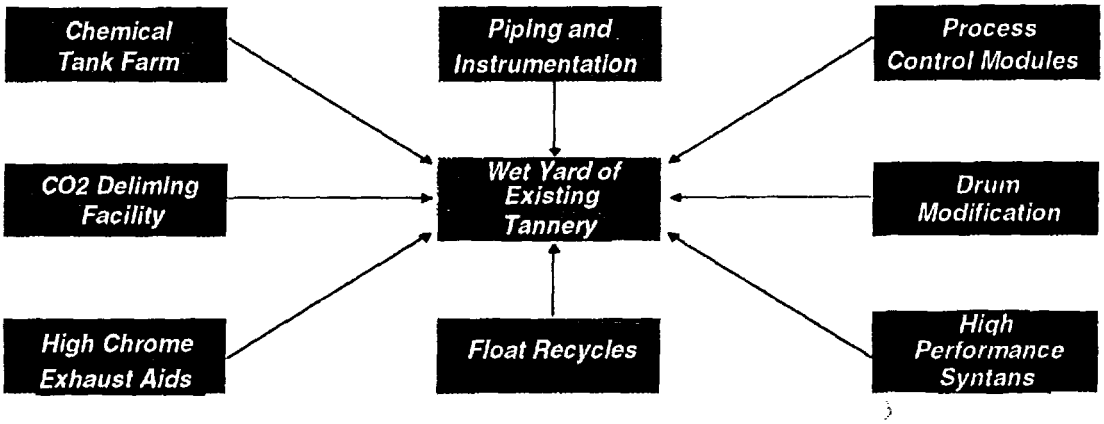


FIG.2.1 : ADD-ON FACILITIES AND TECHNOLOGIES IMPLEMENTED IN THE EXISTING WET YARD OF A TANNERY

i) Incorporation of CO_2 deliming facility along with necessary control instrumentation.

ii) Installation of input monitoring facility for chemical and water additions with appropriate data logging systems. These are developed by CLRI and the Madras Centre of the Central Electronic Engineering Research Institute (CEERI), Pilani, India.

iii) Application of high chrome exhaust aids and high performance syntans for better chrome management.

iv) Reorganization of the existing wet section in the host tannery by equipping it with working platforms, improved drains and chemical handling systems.

2.4 Execution of Agreement with M/s.Tejoomals Limited

The Central Leather Research Institute (CLRI) had entered into an agreement with M/s.Tejoomals Limited on 31st May 1993 for implementing the above project at their tannery site at Pernambut, Tamilnadu State, India. The scope of the agreement covers :

i) Installation, commissioning and demonstration of the process technology by CLRI, Madras.

ii) The Tejoomals shall supply at its own cost the requisite quantity of chemicals/raw materials within ten days from the date of such a request by the CLRI.

iii) The Tejoomals shall provide free access to the CLRI and UNIDO personnel to visit the site as and when required.

iv) The Tejoomals shall allow demonstration of the operational aspects of the control and other systems and the efficacy of the technology to the interested representatives of the leather industry as recommended by CLRI/UNIDO. This facility shall be made available for demonstration for a period of 3 years and can be extended on mutual agreement with UNIDO/CLRI. The exact time and duration of each demonstration shall be finalized by CLRI in consultation with Tejoomals.

v) Tejoomals shall also participate in techno-economic assessment of the technology.

2.5 Financial Arrangement

To facilitate the above, M/s.Tejoomals had earmarked a sum of Rs.1 million as their counterpart implementation cost. The following facilities were created at their site :

i) Civil works covering working platforms, control room and drain system

ii) Drum modifications

iii) CO_2 deliming accessories

iv) Pipings and fittings

v) Accessories to liquid addition systems

vi) Electrical/electronic accessories

The following financial arrangement was agreed by M/s.Tejoomals Ltd:

Rs.0.5 million	already paid to CLRI on signing the agreement
Rs.0.5 million	pledged for making payment for procurement of equipments/facilities and services as specified by CLRI from time to time during the implementation of the proposed activity

A copy of the agreement is given in **Section 2.3**.

2.6 Project Milestones and Time Targets

The most important events pertaining the various phases of project implementation have been identified alongwith appropriate time sequencing (**Table 2.1**). The originally fixed milestones are given below :

MILESTONES

1.	Projected cost estimates including work plan to be sent to UNIDO	:	23 Nov 1992
2.	Equipment specifications to be sent to UNIDO	:	30 Nov 1992
3.	Finalisation of contract with the user tannery	:	31 Mar 1993
4.	Design package preparation	:	31 Mar 1993
5.	Ordering of all equipments	:	30 Apr 1993
6.	Selection of Implementation Agencies	:	30 Apr 1993
7.	Receipt of equipment/local fabrication	:	30 Jul 1993
8.	Civil works completion	:	30 Jul 1993
9.	Installation of equipments	:	30 Nov 1993
10.	Testing and Commissioning	:	30 Dec 1993
11.	Demonstration to other tanneries	:	01 Jan 1994

The actual testing and commissioning could be done after a time overrun of 12 months. The reasons for this delay are highlighted in General Section of this report.

Table 2.1 : Proposed Work Plan for Implementation of Ammonia Free and Cleaner Wet Tanning Operations

Starting Date : 1st October 1992

		MONTHS															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Finalization of contract with the user tannery	xxx x	xxx x													
2	Projected cost estimates including work plan to be sent to UNIDO	xxx x	xx													
3	Equipment specification to be sent to UNIDO		xxx x													
4	Basic Engineering package preparation			xxx x												
5	Selection of Imple-mentation Agency					xxx x	xxx x									
6	Ordering of Equipments			xxx x	xxx x	xxx x	xxx x	xxx x								
7	Receipt / Fabrication of Equipment						xxx x	xxx x	xxx x	xxx x	xxx x					
8	Civil works								xxx x	xxx x	xxx x					
9	Installation of equipment and testing											xxx x	xxx x	xxx x		
10	Commissioning												xxx x	xxx x	xxxx	
11	Demonstration and Report Preparation / Training												xxx x	xxx x	xxxx	

2.2 USER AGENCY PROFILE

M/S.TEJOOMALS LEATHER DIVISION, PERNAMBUT (TAMIL NADU)

* 2000 - 2500 Kgs soaking capacity
* 1500 Kgs Wet Blue to finish
* 3000 - 4000 Sqft/day
* Type of processes/leathers
  - Raw to Wet Blue
  - Semi Chrome Buff Calf (Burnish)
  - Full Chrome Cow Waxy

2.3 USER AGENCY-CLRI CONTRACT

AGREEMENT

BETWEEN

TEJOOMALS Leather Division
PERNAMBET

AND

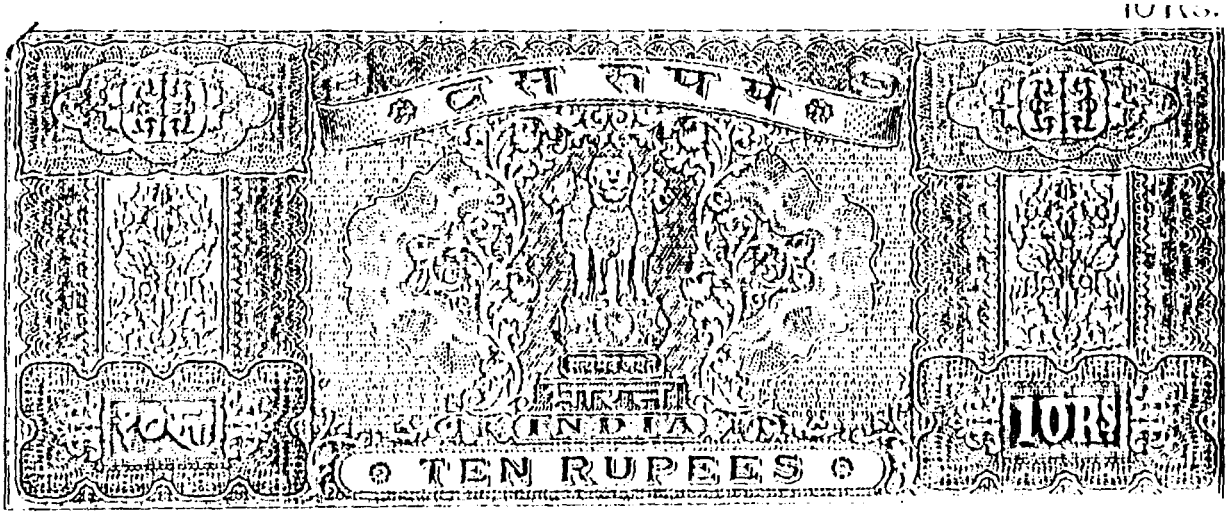
CENTRAL LEATHER RESEARCH INSTITUTE
MADRAS

FOR

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGY UNDER THE UNIDO PROJECT NO. US/IND/90/244/2

TEJOOMALS Leather Division,
Ambur Road,
Pakklapalli,
Pernambet.

Central Leather Research
Institute
Adyar
Madras 600 020



DIRECTOR
C.L.R.I.
MADRAS-20

V. PRABHAKAR RAO, M.A.
STAMP VENDOR,
L. NO 9581/92
No. 8, IIIrd Cross Street,
Kasturibai Nagar, Adyar, Ms-20.

C.1. THE AGREEMENT

C.1.1. THIS AGREEMENT made and entered into force this One thousand nine hundred and Ninety three between Council of Scientific & Industrial Research, a Society registered under the Societies Registration Act XXI of 1860, having its registered office at Anusandhan Bhavan, 2, Rafi Marg, New Delhi 110 001, (hereinafter called CSIR which expression shall where the context so admits include its successors and permitted assigns) through the Central Leather Research Institute, Adyar, Madras-600 20(hereinafter referred to as CLRI)

C.1.2. M/s TEJOOMALS LIMITED, Ambur Road, Pakklapalli, Pernambet, a Company registered in India under the

For TEJOOMAL'S LEATHER CORPORATION

Director

N. SATYANARAYANA
Controller of Administration
Central Leather Research Institute
ADYAR, MADRAS-600 020

Companies Registration Act 1950 and having its registered office at 13/1 A, Mirza Ghalib Street, Calcutta (hereinafter called as TEJOOMALS which expression shall where the context so admits includes its successors and permitted assigns) of the other part.

C.2. PREAMBLE

United Nations Industrial Development Organisation(UNIDO) Vienna(hereinafter referred to as UNIDO) has identified Central Leather Research Institute, Adyar, Madas-600 020 under Project No.US/IND/90/244/2 as the agency for implementation of Environmentally cleaner technology at selected tanneries in India. CLRI in consultation with UNIDO has chosen TEJOOMALS as the host organisation for setting up demonstratoion facility costing approximately Rs.30 lakhs (hereinafter referred to as ACTIVITY) for ammonia free and cleaner wet tanning operations (hereinafter referred to as TECHNOLOGY. The basic objectives of the proposed ACTIVITY AND TECHNOLOGY TRANSFER are:

i. to reduce ammonia, chromium and other toxic chemical/biological load in the tannery waste leather through improved in process measures and implemention of cleaner technoligies.

ii. to achieve better water management

iii. to minimize rejects and batch to batch variation of leather quality through improved in-process control measures.

For TEJOOMAL'S LEATHER DIVISION

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iv. to create better working environment and improved house-keeping in tannery wet section.

v. to minimize occupational health hazards of chemical handling and processing techniques.

vi. to provide on-job training to the host tannery personnel in operation and maintenance of the new facilities.

C.3. SCOPE OF THE AGREEMENT

The agreemnent details the terms and conditions, for CLRI undertaking the activity for the TEJOOMALS, the financial arrangements, rights and obligations of the parties hereto, pertaining to the ACTIVITY.

C.4. FINANCIAL ARRANGEMENT

C.4.1 TEJOOMALS shall earmark a sum of Rs. 10,00,000/- (Rupees ten lakhs only) towards the counterpart implementation costs (30% of the project cost) for implementing the items listd in Annexure-I.

Rs.5,00,000/- to be paid to CLRI on signing the agreement

Rs.5,00,000/- to be pledged for making payment for procurement of equipments/facilities and services as specified by CLRI from time to time during the implementation of the proposed ACTIVITY.

C.4.2 TA/DA CHARGES

The TEJOOMALS shall in addition to charges as above pay to CLRI for the personnel deputed in connection with work peraining to the ACTIVITY, provide boarding and lodging and

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local hospitality at the work place.

C.5. RESPONSIBILITIES OF CLRI

C.5.1 CLRI shall undertake the ACTIVITY in accordance with the scope of work detailed in the Annexure I to the agreement.

C.5.2 CLRI shall complete the ACTIVITY including submission of the Final Report within 15 months of signing the agreement.

C.5.3 The period for completion of ACTIVITY could however, be extended to such further period as may be required and mutually agreed between the parties without any liability on the part of CLRI.

C.5.4 CLRI shall provide design engineering including equipment specification for the implementation of ACTIVITY.

C.5.5 CLRI shall provide technical assistance during equipment procurement, installation, commissioning and demonstration.

C.5.6 CLRI shall provide the following documentasion for the proposed facility:

i) Operation manual

ii) Process recipie for environmentally cleaner technologies

iii) Safety manual

iv) Instructions for operation and maintenance of all the critical equipments

v) Specification of chemicals, specially needed for implementation of environmentally cleaner technologies.

C.5.7 CLRI shall provide training to the personnel of TEJOOMALS (number to be mutually agreed upon) on the following aspects:

i. CO_2 gas handling and flow monitoring

For TEJOOMAL'S LEATHER DIVISION

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ii. Controlled addition of water and chemicals with appropriate instrumentation

iii. Online monitoring of process parameters

iv. Operation of pH control system attached to the drum

v. Safe handling of chemicals and rotating equipments

vi. Data logging and information retrieval

vii. Time sequencing of process operations

C.5.8 CLRI shall demonstrate three batches of the TECHNOLOGY to the TEJOOMALS.

C.6. RESPONSIBILITIES OF THE TEJOOMALS

C.6.1 The Tejoomals shall supply at its own cost the requisite quantity of chemicals/raw materials to CLRI within ten days form the date of such a request by the CLRI

C.6.2 The Tejoomals shall provide free access to the CLRI and UNIDO personnel to visit the site as and when required.

C.6.3 The TEJOOMALS shall allow demonstration of the operational aspects of the control and other systems and the efficacy of the TECHNOLOGY to the interested representatives of the leather industry as recommended by CLRI/UNIDO. This facility shall be made available for demonstration for a period of 3 years and can be extended on mutual agreement with UNIDO/CLRI. The exact time and duration of each demonstration shall be finalized by CLRI in consultation with TEJOOMALS.

C.6.4 TEJOOMALS shall also participate in techno-economic assessment of the TECHNOLOGY AND ACTIVITY.

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for TEJOOMAL'S LEATHER DIVISION

Director

C.6.5 TEJOOMALS shall nominate a coordinator who shall be the contact person for CLRI from time to time to monitor the progress of the project.

C.6.6 TEJOOMALS shal also provide all basic data/details/information/manuals available with them and as required by CLRI in respect of their existing facilities and technologies.

C.6.7 TEJOOMALS shall, consequent to the ACTIVITY undertaken by CLRI and upon implementation of results thereto, disclose to CLRI benefits accrued to it in techno-economic and other terms for information.

C.6.8 TEJOOMALS shall provide adequate personnel/equipment support for CLRI personnel and CLRI will not be responsible for any unwilful damage caused to the property/machinery of the TEJOOMALS during the couse of this project.

C.6.9 TEJOOMALS shall provide necessary financial support for the procurement of all the machinery, equipment and facilities as per directions of CLRI within the budgeted amount as highlighted in C.4.1 and shall be responsible for its maintenance and operation.

C.6.10 The equipments and facilities to be procured from UNIDO funds will be in UNIDO's name till all obligations under this agreement are fulfilled by TEJOOMALS. The transfer of assets to TEJOOMALS will then follow.

C.7 EFFECTIVE DATE, DURATION AND TERMINATION OF AGREEMENT

C.7.1 The agreement shall be effective form the date of signing the agreement and shall remain in force for the period of 15 months form the effective date.

For TEJOOMAL'S LEATHER DIVISION

Director

Director

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C.7.2 During the tenure of the agreement parties hereto can terminate the agreement either for violation of any of the clauses of the agreement or other work by giving one month notice in writing to the defaulting party. Failure of either party to terminate the agreement on account of breach or default by the other shall not constitute a waiver of the party's right to terminate this agreement.

C.8. SETTLEMENTS

C.8.1 In the event of termination of the agreement vide C.7.2 the rights and obligations of the parties hereto shall be settled by mutual discussion the financial settlement shall take into consideration not only the expenditure incurred but also the expenditure committed to UNIDO by CLRI.

C.9. CONFIDENTIALITY

C.9.1 During the tenure of the agreement and for a period of 7 years of its expiry, both CLRI AND the TEJOOMALS (including their sub-contractors if any) shall treat as strictly confidential and prevent disclsure thereof of all the information and data exchanged/generated under this agreement for any purposes other than that in accordance with this agreement.

C.10. GENERAL PROVISIONS

C.10.1 The CLRI shall during the tenure of the agreement or thereafter, be free to take up, without any prejudice to the TEJOOMALS, consultancy work similar to or same as the ACTIVITY, for other parties on terms and conditions a it may decide upon.

For TEJOOMAL'S LEATHER DIVISION

Director

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C.11. COMPLETION OF ACTICVITY

C.11.1 The ACTIVITY shall be deemed to have been successfully completed on submission on the Final Report as stated hereinbefore by the CLRI to the TEJOOMALS.

C.12 PUBLICATIONS

C.12.1 Publications, if any, in respect of the ACTIVITY shall be in the names of S & T personnel of CLRI connected with the ACTIVITY. In all publications (papers, reports etc.), it will be duly acknowledged that the work has been carried out by CLRI under a consultancy assignment form the TEJOOMALS.

C.13 FORCE MAJEURE

C.13.1 Neither party shall be held responsible for non-fulfilment of their respective obligations under this agreement due to the exigency of one or more of the force majeure events such as but not limited to Acts of God, war, flood, earthquakes, strike lockouts, epidemics, riots, civil commotion etc provided on the occurance and cesation of any such events, the party affected thereby shall give a notice in writing to the other party within one month of such occurance or cessation. If the force majeure conditions continued beyond six months, the parties shall then mutually decide about the future course of action.

C.14 NOTICES

All notices and other communications required to be served on the TEJOOMALS under the terms of this agreement, shall be considered to be dully served if the same shall have been delivered to left with or posted by registered mail

For TEJOOMAL'S LEATHER DIVISION

Director

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Controller of Administration
केन्द्रीय चर्म अनुसंधान संस्थान
Central Leather Research Institute
अड्यार ADYAR, मद्रास MADRAS-600 020

to the TEJOOMALS at its last known address of business. Similarly, any notice to be given to the CLRI shall be considered as duly served if the same shall have been delivered to, left with or posted by registered mail to the CLRI at its registered address in New Delhi.

C.15 ARBITRATION

C.15.1 Except as hereinbefore provided, any dispute arising out of this agreement, shall be refered to the arbitration of two arbitrators, one to be appointed by each party to the dispute, and in case of difference of opinion between them to an umpire appointed by the said two arbitrators before entering on the reference, and the decision of such arbitrators or umpire, as the case may be shall be final and binding on both parties. The venue of arbitration shall be at such place as may be fixed by such arbitrators or umpire and the arbitration proceeding shall take place under the Indian Arbitration Act, 1940

C.16 AMENDMENTS TO THE AGREEMENT

C.16.1 No amendment or modification of this agreement shall be valid unless the same is made in writing by both the parties or their authorised representatives and specifically stating the same to be an amendment of this agreement. The modifications/changes shall be effective from the date on which they are made/executed, unless otherwise agreed to.

एन. सत्यनारायण
N. SATYANARAYANA
प्रशासन-नियंत्रक
Controller of Administration
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Central Leather Research Institute
अड्यार ADYAR, मद्रास MADRAS-600 020

For TEJOOMAL'S LEATHER DIVISION

Director.

SEAL OF PARTIES

In witness thereof the parties hereto have signed this agreement on the date, month and year mentioned hereinbefore. Parties

For and on behalf of CLRI	For and on behalf of TEJOOMALS
	For TEJOOMAL'S LEATHER DIVISION
Signature	Signature
Designation	Designation Director
Seal	Seal
Witnesses (Name & Address)	Witnesses (Name & Address
1	1
2	2
Date	Date

एन. सत्यनारायण
N. SATYANARAYANA
प्रशासन-निदेशक
Controller of Administration
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Central Leather Research Institute
अड्यार ADYAR, मद्रास MADRAS-600 020

COUNTERSIGNED

Finance & Accounts Officer
Central Leather Research Institute
Adyar, Madras-600 020

ANNEXURE I

Facilities to be cereated with counterpart funding from TEJOOMALS

1. Civil works covering working platform, control room and drain system.
2. Drum modifications
3. CO_2 deliming accessories
4. Pipings and fittings
5. Accessories to liquid system
6. Electrical/electronic accessories
7. Installaction and other miscellaneous jobs.

For TEJOOMAL'S LEATHER DIVISION

Director

एन. सत्यनारायण
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3. PROCESS TECHNOLOGY

3.1 Manufacturing process followed before Implementation

The tannery process cow hides from raw to dyed crust. The processing followed by them conventionally is as below :

Soaking	:	The hides are cut in to sides and soaked overnight in pits.
Liming	:	The hides are limed for 2 days with lime and sodium sulfide in paddles. Then they are taken for fleshing.
Deliming & Bating	:	Deliming is generally carried out using a mixture of ammonium chloride and ammonium sulfate in 1:1 ratio. After completion of deliming bating is carried out in the same float.
Pickling	:	Overnight pickling is carried out in the tannery. After completion of acid addition, the hides are left in the bath overnight. Next day after checking the pH the pelts are taken for tanning.
Tanning	:	Tanning is carried out using 8% BCS. Completion of tanning is normally judged by conducting boil test. After splitting and shaving, the hides are taken for rechroming.
Rechroming	:	Rechroming is normally carried out using 5% BCS. Neutralization, Retanning, Dyeing & Fat liquoring are carried out manually in the conventional way and the pH of neutralization & quantity of chemicals vary depending on the end product.

The process receipe and the process flow diagram for the process followed in the tannery for the two types of finished products are given in **Annexure I & II** respectively

3.2 Process modifications and control strategies adopted

To meet the objectives mentioned above, following process modifications & control strategies have been adopted.

- Ammonia free (carbon-di-oxide) deliming
- High exhaustion chrome tannage
- Rechroming with high performance syntans
- pH control and recycling system
- Chemical preparation and dosing system
- Hot water generations and additions
- Improved drainage system

3.2.1 Ammonia Free Deliming

Ammonium salts are ideally suited for the technological requirements of deliming as they can act as buffers and readily react with lime. However, use of ammonium salts adversely affect the effluent characteristics and create an unpleasant

working condition. Conventional ammonium deliming contributes nearly 75-80% of ammonia in the effluent. Use of organic acids for deliming is often associated with the problem of drawn grain (or) acid shock resulting in poor grain qualities and area yield. Carbon-di-oxide does not pose these problems when used for deliming as it has an ability to act as buffer in the float. It has high affinity for lime and is comparatively inexpensive to use.

The other advantages associated with carbon-di-oxide deliming are :

- Reduction of nitrogenous discharges in the effluent
- Reduction of BOD & COD to an extent of 50%
- Reduction in ammonia odour
- Improved grain characteristics and
- Easy handling and automation ability

The process adopted for deliming is given below. Carbon-di-oxide is let into the drum through the axle hold by a rubber tubing attached to a manifold system connecting of 3 or 4 carbon-di-oxide cylinders. The carbon-di-oxide flow can be controlled through a ball valve and pressure regulator. The rate of flow can be closely monitored through a flow meter.

The critical operating parameters which have decisive influence on the efficiency of the system and quality of the leather are :

- hide - float ratio
- carbon-di-oxided gas addition rate and
- time of bate addition

Hide - float ratio is an important factor for carbon-di-oxide deliming. Higher float levels allow better dissolution of carbon-di-oxide resulting in promotion of faster deliming. A float level of 150% on the limed pelt weight has been recommended for successful deliming. The time taken for carbon-di-oxide deliming is more or less same as that of conventional ammonium deliming.

The rate of addition of carbon-di-oxide is another important factor for proper deliming. To speed up the process and to overcome the lime blast problem, high flow rates of carbon-di-oxide is suggested initially until the buffering pH of 6.5-7.0 is reached. Then the flow rate of carbon-di-oxide is brought down till completion of deliming as inferred from the disappearance of pink colour at the cross section of pelt when tested with phenolphthalein.

Since most of the bate formulations available in the market have maximum activity at a pH of 8.3, it is desirable to add the bate immediately after commencement of carbon-di-oxide injection as the pH drops down to a level around 7.0 during most of the deliming period.

commencement of carbon-di-oxide injection as the pH drops down to a level around 7.0 during most of the deliming period.

3.2.2 High exhaustion chrome tannage

Nearly 85% of finished leathers in India are processed by using chrome tanning system. Normally, basic chromium sulfate with following characteristics is used for tanning.

Cr_2O_3	-	25%
Basicity	-	33.1/3%
pH of 10% solution	-	3.0-3.5

In practice, 8-10% of basic chromium salt is normally used for effective tanning. Any chrome tanning salt used for tanning would have a fraction which consist of components which possess affinity i.e. the ability to bind to the hide/skin without any modification/use of external aids. Generally in a typical chrome tanning system employed in commercial tanneries, the fraction having ready affinity to hide/skin may constitute 50-65% of the total chrome used. The remaining component of chromium for reasons of lack of either affinity or high liability exhibits poor exhaustion behaviour. Under general conditions employed for tanning, the normal chrome tanning salt used has poor exhaustibility with as much as 35-50% of chromium left out on the tanning bath.

levels. This can be done by modifying the affinity of the chrome tanning salt and / or introducing more reactive sites for the chromium to reach.

Use of a polyamide chrome exhaust aid (commercial product) at 1.0% (on pelt weight) level has been found to enhance the chromium uptake by 15-20% leading to substantial pollution reduction and material saving.

3.2.3 Rechroming with high performance syntan

The problem associated with chromium is much more in rechroming as the exhaustion rates of chrome is only 50-55%. It has been suggested to use a high performance mineral (chromium-aluminium) based syntan in the place of chrome on partial/complete replacement basis depending on the properties required for the final product. These syntans are capable of effectively fixing 90% of aluminium & chromium present in them irreversibly, unlike conventional basic chromium sulfate. For upper leathers, chrome has been replaced to an extent of 75% by high performance syntans. In the case of softy leathers, 100% replacement of chrome has been suggested.

3.2.4 pH control & float recycling system

The float recycle system comprises of tube assembly which collects the process liquor during lower half cycle of rotation of drum and delivers into collector fitted inside the manhole during upper half cycle of rotation of drum. The process liquor

flows back to the drum through the pH chamber which houses the electrode for pH monitoring. The pH indicator-transmitter continuously monitors the process liquor. The pH control system controls addition of critical chemicals which automatic end point indication.

3.2.5 Chemical preparation & dosing system

The critical & bulk chemicals are stored in bulk storage tanks (one for sulfuric acid, one for formic acid, one for alkali & two for fat liquors) and are drawn into the load cell as per the process requirements. From the load cell, chemicals are fed into the drums through the auxiliary tanks either in feeds or continuously.

3.2.6 Hot water generation & addition

A steam - water mixer is provided with flow indicator controller and temperature controller to generate required hot (since the boiler facility is not available, this unit is not tested). Since the hide-float ratio is one of the important factor which decides the uptake & distribution of chemicals and quality of the leather, this module helps in better exhaustion of chemicals & improve the quality of leathers. During the experiments, hot water prepared separately is used.

helps in better exhaustion of chemicals & improve the quality of leathers. During the experiments, hot water prepared separately is used.

3.2.7 Improved drainage systems

Inorder to create a better working environment, improved drainage systems has been provided in the tannery. This system helps in segregating the spent liquors to avoid mutual precipitation & subsequent clogging of drains apart from removing solid materials through appropriate screening. The flooring of the drum yard has been altered to prevent spill overs in the path way & to collect the liquors in the drains easily.

4. PLANT AND EQUIPMENTS

4.0 Plant and Equipments

This section gives details of the hardware used in this project. The major components of the hardware are tanks with & without stirrer, pumps, instruments, computer, platforms etc. The details of site like, location of drums etc. was collected and layout was prepared.

The bulk tank sizes were fixed with the aim of holding solution for atleast three days requirement. The intermediate tank sizes were fixed such that in majority of the cases, the tanks will hold one batch requirement. Two different types of samples for float recycle were designed, fabricated and tested before implementing. The specifications of all equipments used are given in **Annexure III.1**. The fabrication of tanks, erection, installation of piping and pre-commissioning was awarded on contract. The details are given in Section 5.

The piping and instrument diagram is prepared (**Fig.4.1**) and based on this the pipe sizes, control valves and the instrument specification were fixed. The specification of instruments used are given in **Annexure III.2**.

To estimate the bill of material for piping, cabling etc. an isometric diagram of the plant is made and is shown in **Fig. 4.2, 4.3 & 4.4** along with plan & elevation.

A single line electrical wiring diagram (**Fig.4.5**) and sub switch board (**Fig.4.6**) layout is prepared. Based on these and layout a bill of material, with specification is prepared for electrical wiring. The bill of material is given in **Annexure III.3**.

A layout (**Fig.4.7**) and design is made for the control cabin for housing the computer and its accessories. The main operation of the unit is planned to be carried out from here, hence it was located strategically, such that the operator can have full view of the unit. The bill of material for the control cabin was prepared and this is given in **Annexure III.4**.

The platform were designed to house the chemical feeding of bulk and batch tanks. A general layout of the units along with platforms is shown in **Fig.4.8** for proper drainage of the effluents, effective drainage system is designed as shown in **Fig.4.9**. The bill of material prepared for civil works is given in **Annexure III.5**.

Broad specification of major equipments used in the system is given in **Table 4.1**.

Table 4.1 : Broad Specifications of Equipments

Item No	Equipment / Facility	Quantity
1.0	Civil Works	
1.1	Working Platform	
1.2	Process Control Rook	
1.3	Drain System	
2.0	Drum Modification	
2.1	Drain side entry modification	
2.2	Vent line	
2.3	Liquor drawing facility	
2.4	Pump around system	
2.4.1	Centrifugal pumps (Polypropylene; 70 lpm; Head : 2 m)	5 nos
2.4.2	pH Transmitter (Range 0-14; Accuracy + 0.1ph : 4-20 mA Output)	5 nos
2.5	CO_2 Deliming system	
2.5.1	CO_2 Gas cylinders (50 kgs; 10 kg/cm^2; Seamless; Steel with Pr Regulator and flow meter	2 nos
2.5.2	CO_2 Absorber / Saturator	1 no
2.5.3	Weighing Balance for CO_2 cylinder (100 kgs)	1 no
3.0	Chemical Storage Tanks with Nozzles	
3.1	HDPE/FRP storage tanks - 1000 lts - 250 lts	 5 nos 3 nos
3.2	HDPE/FRP storage tanks with stirrer (RPM 400) and suitable supports (cap 250 l)	4 nos
4.0	Pumps and Compressors	
4.1	Air compressor with storage Tank; Oil filter etc (5-7 m^3/hr; 8-10 kg/cm^2)	1 no
4.2	Chemical addition system pump (polypropylene; 100-150 lpm; Head 10 M)	1 no
4.3	Chemical transfer pumps (polypropylene; 50 lpm; Head 5 M)	5 nos
5.0	Piping and Fittings	
6.0	Liquid Addition Systems	
6.1	Chemical addition system	
6.1.1	Load cell, stain gauge type 500 kg capacity with + 100 gm accuracy	
6.1.2	Load cell tank with stirrer and supporting structure capacity 500 liters	
6.2	Water addition system	
6.2.1	Steam injection water heater system with RTD (Cap 500 - 600 lpm: outlet water temp 65°C; Inlet/outlet flange size 3")	1 no
6.2.2	Steam control valve (1")	1 no
6.2.3	Flow indicator controller (Cap 100-500 lpm)	1 no
6.2.4	Centrifugal pump (SS304 ; 500 - 600 lpm Head : 5 M)	1 no
7.0	Control Valves and Instruments	
7.1	2-Way SS Ball Valves	30 nos
7.2	2-Way SS Plunger-valves	15 nos
8.0	Control Module 80386 Main processor with 25-40 MHz clock speed with 80387 coprocessor, 1 MB main memory 40 MB Hard Disc and other add on cards, relays, etc.	1 unit
9.0	Electrical Accessories	1 kit
10.0	Installation and other miscellaneous costs	

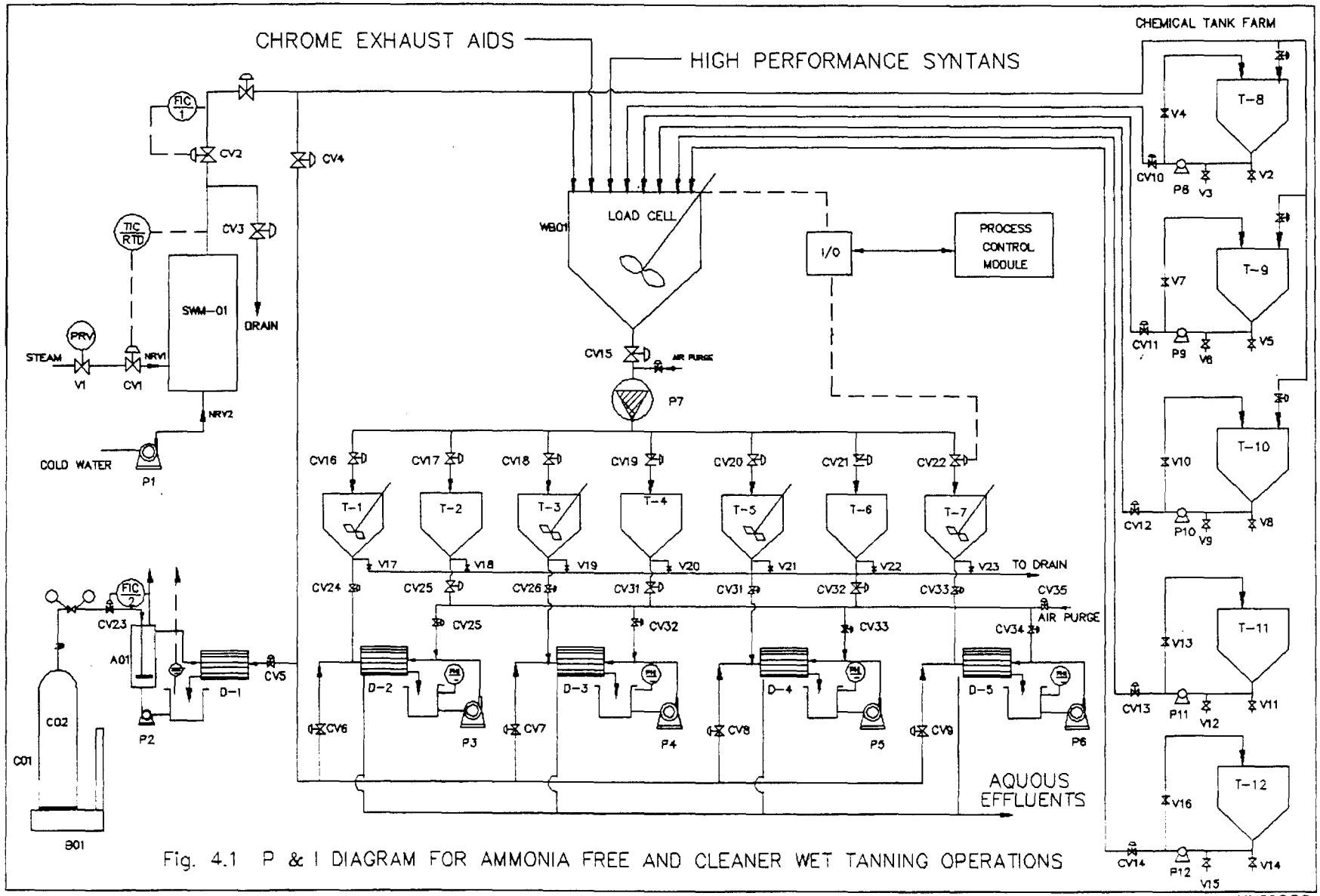

Fig. 4.1 P & I DIAGRAM FOR AMMONIA FREE AND CLEANER WET TANNING OPERATIONS

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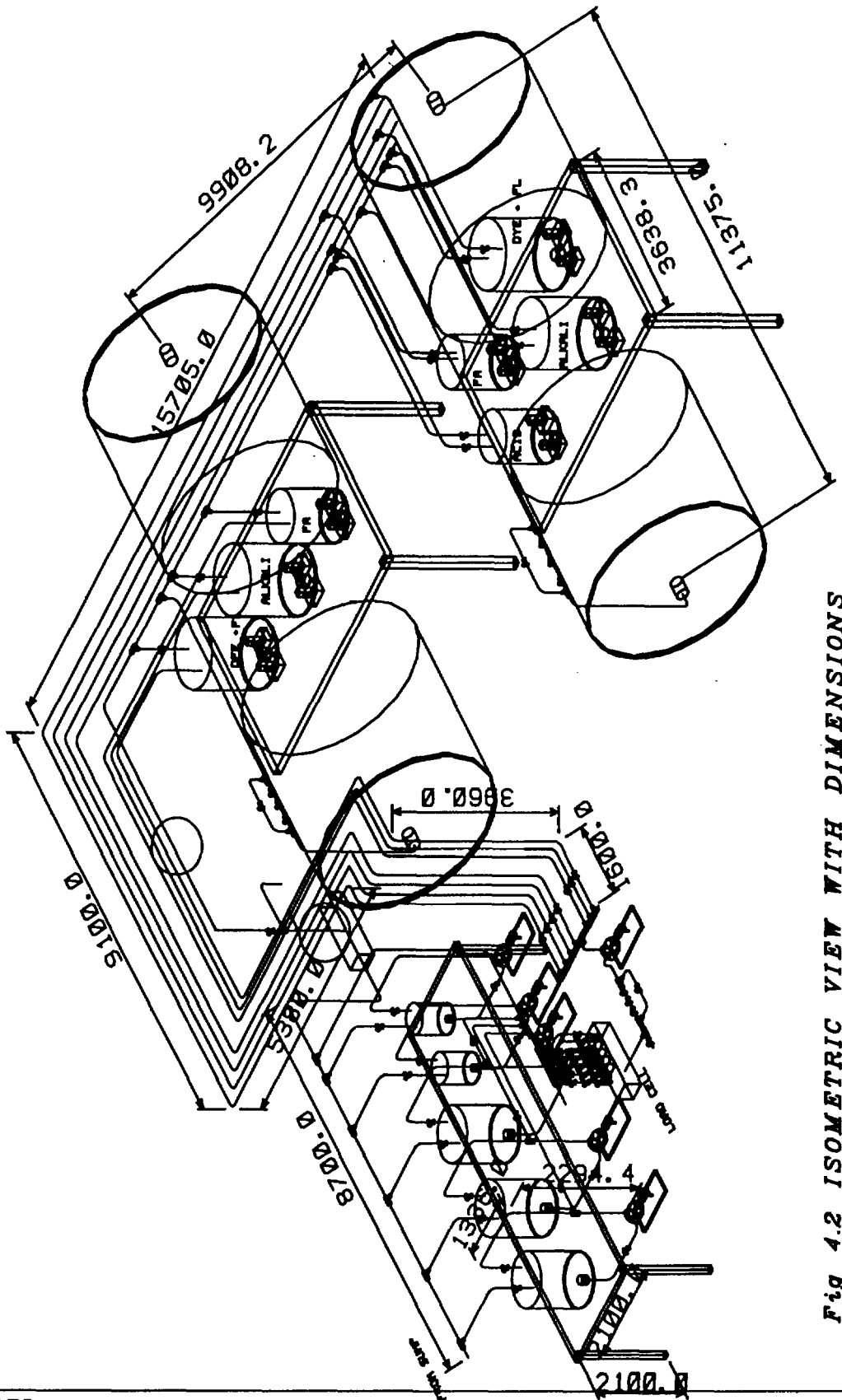
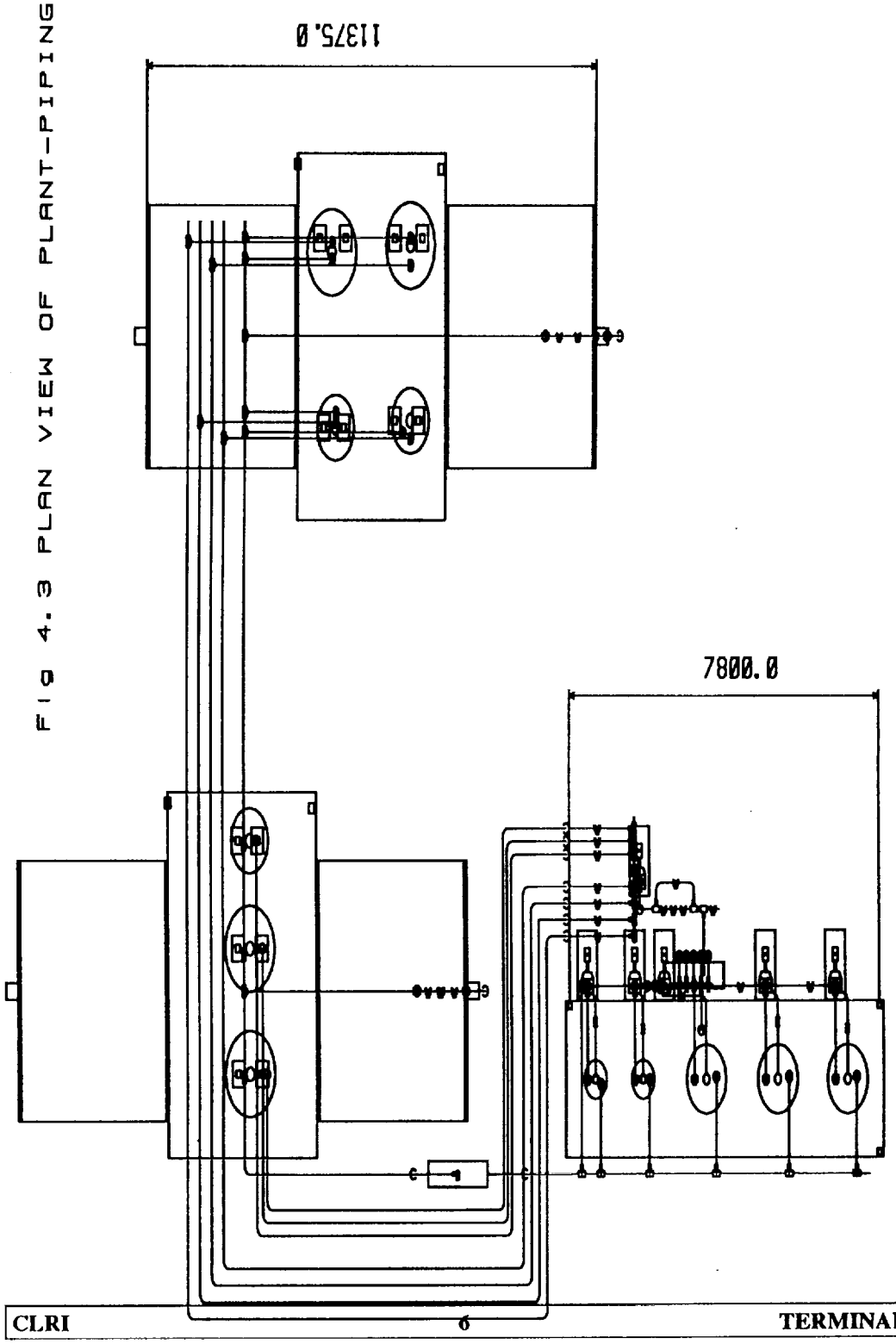


Fig 4.2 ISOMETRIC VIEW WITH DIMENSIONS

Fig 4.3 PLAN VIEW OF PLANT-PIPING MODEL



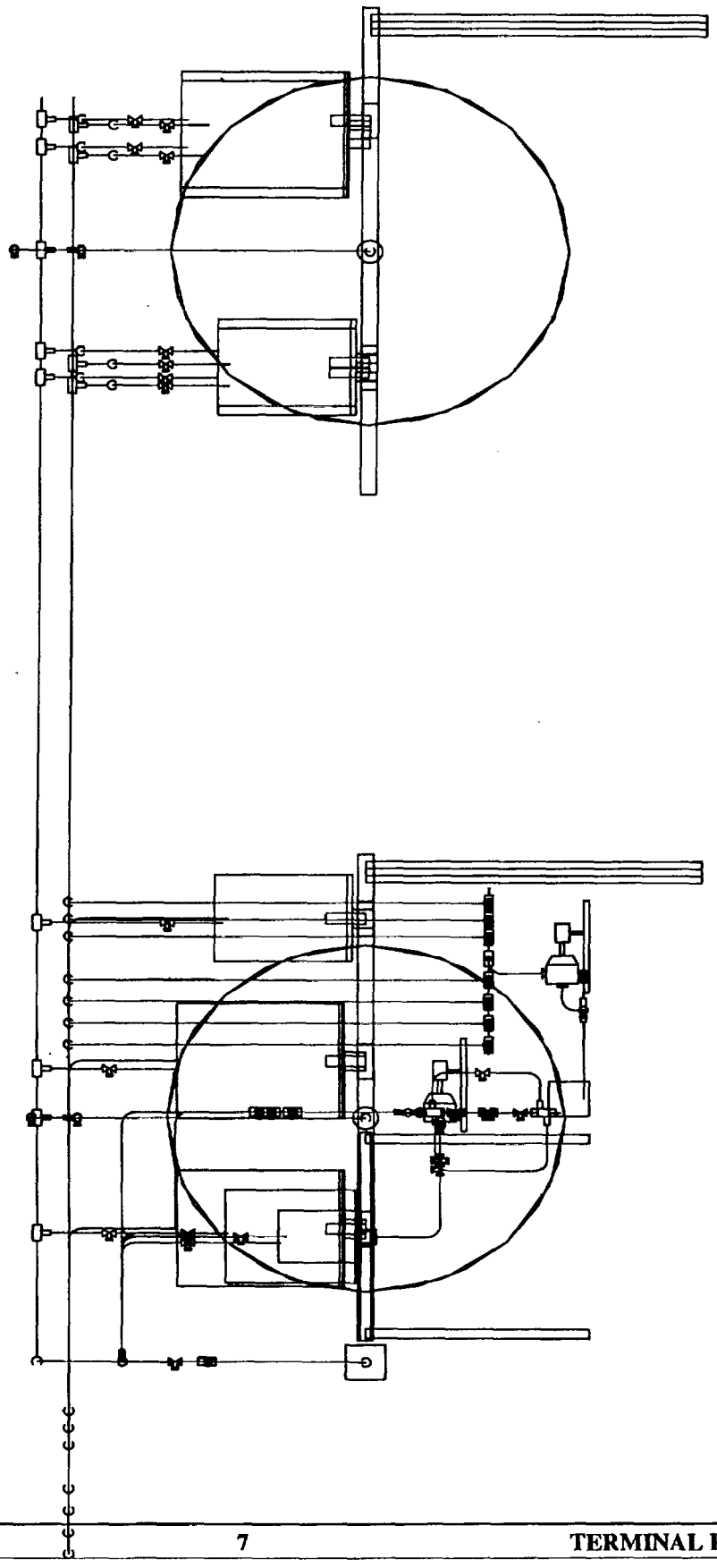


Fig 4.4 FRONT VIEW OF PLANT-PIPING MODEL

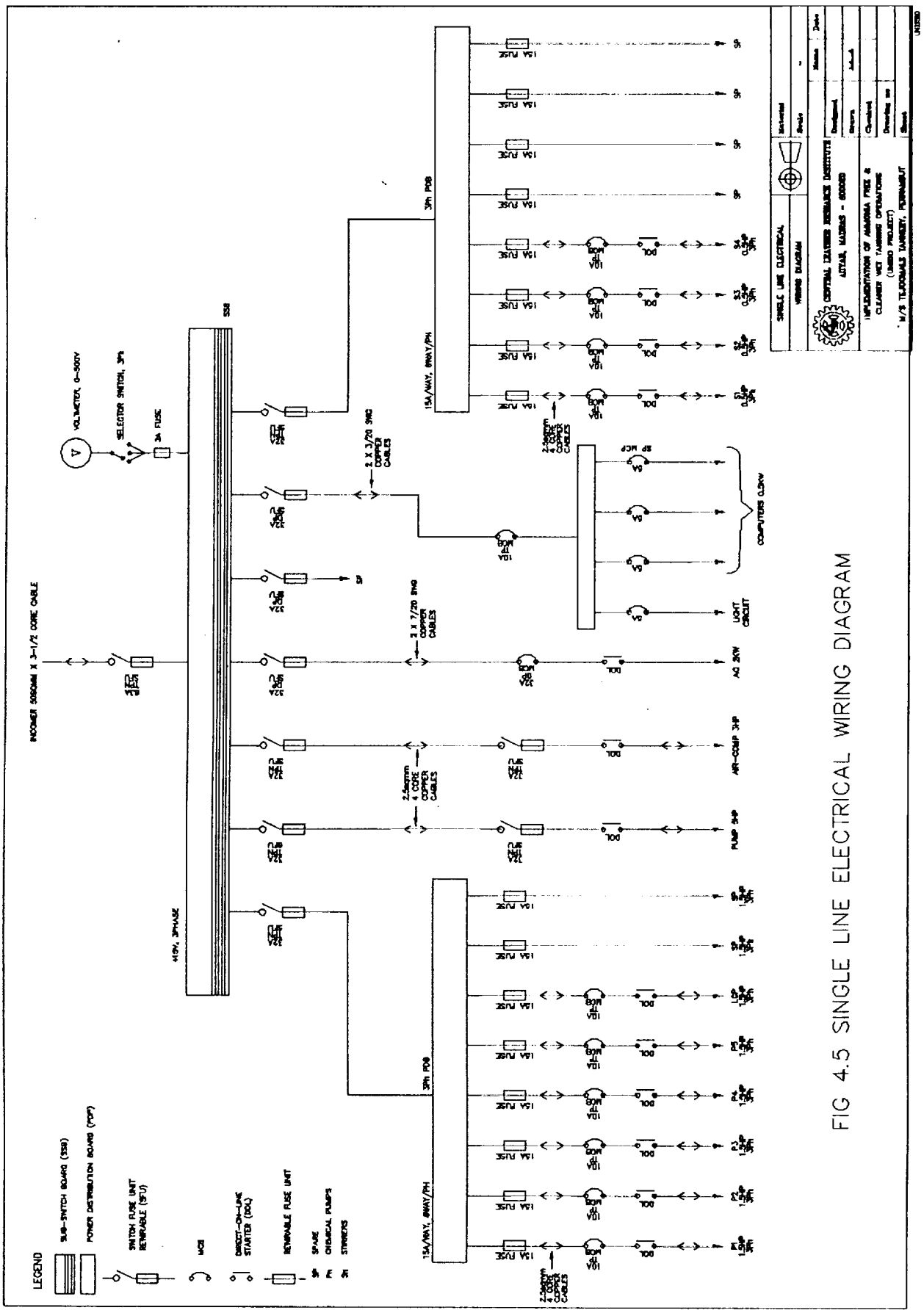


FIG 4.5 SINGLE LINE ELECTRICAL WIRING DIAGRAM

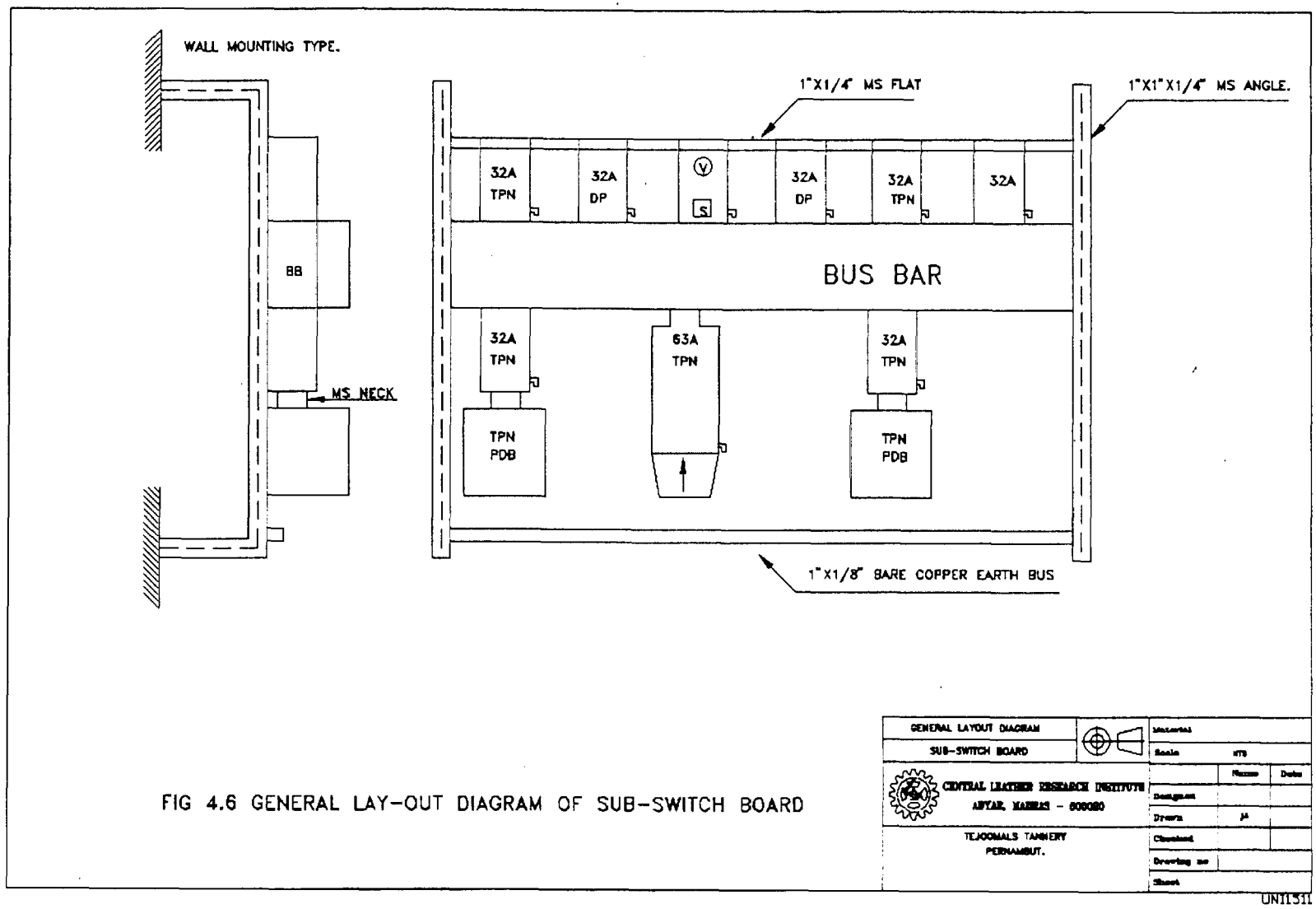


FIG 4.6 GENERAL LAY-OUT DIAGRAM OF SUB-SWITCH BOARD

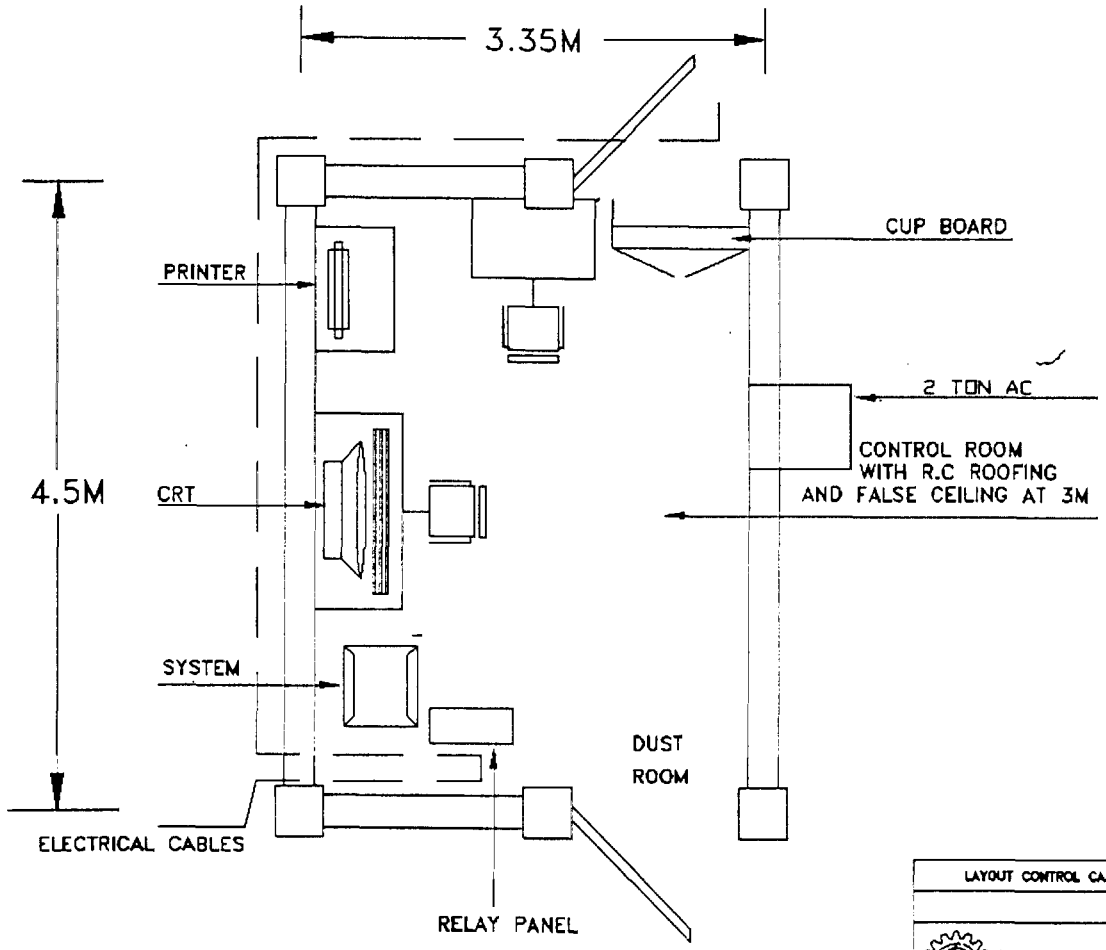


FIG 4.7 LAYOUT OF CONTROL CABIN.

LAYOUT CONTROL CABIN		Material
		Scale
CENTRAL LEATHER RESEARCH INSTITUTE - ADYAR, MADRAS - 600020		Name / Date
	Designed	
	Drawn	JS
TEJOOMALS TANNERY PERNAMBUTT.	Checked	
	Drawing no	
	Sheet	

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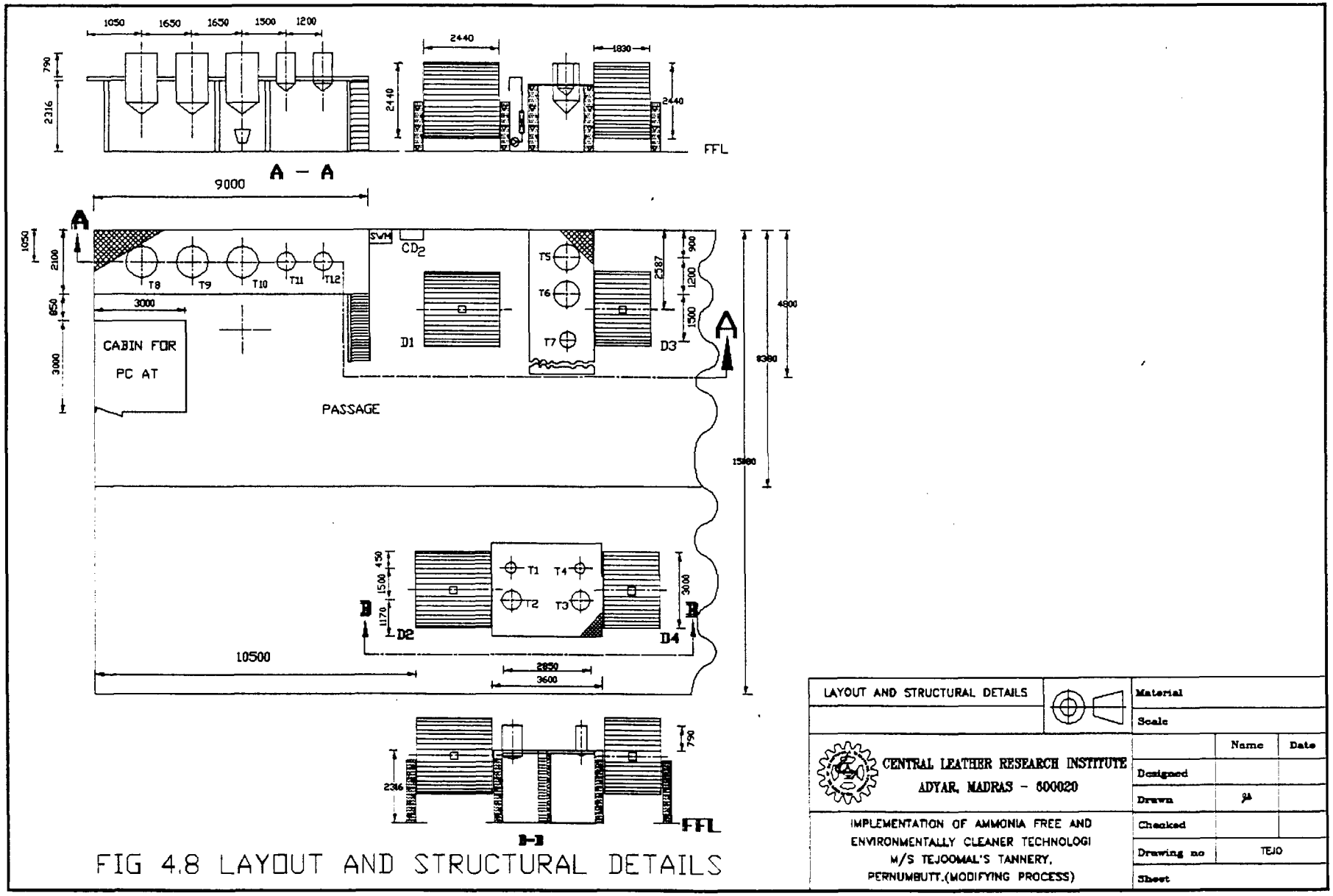

FIG 4.8 LAYOUT AND STRUCTURAL DETAILS

LAYOUT AND STRUCTURAL DETAILS		Material
		Scale
CENTRAL LEATHER RESEARCH INSTITUTE ADYAR, MADRAS - 600020		Name / Date
		Designed
		Drawn
IMPLEMENTATION OF AMMONIA FREE AND ENVIRONMENTALLY CLEANER TECHNOLOGI M/S TEJOOMAL'S TANNERY, PERNUMBUTT.(MODIFYING PROCESS)		Checked
		Drawing no: TEJO
		Sheet

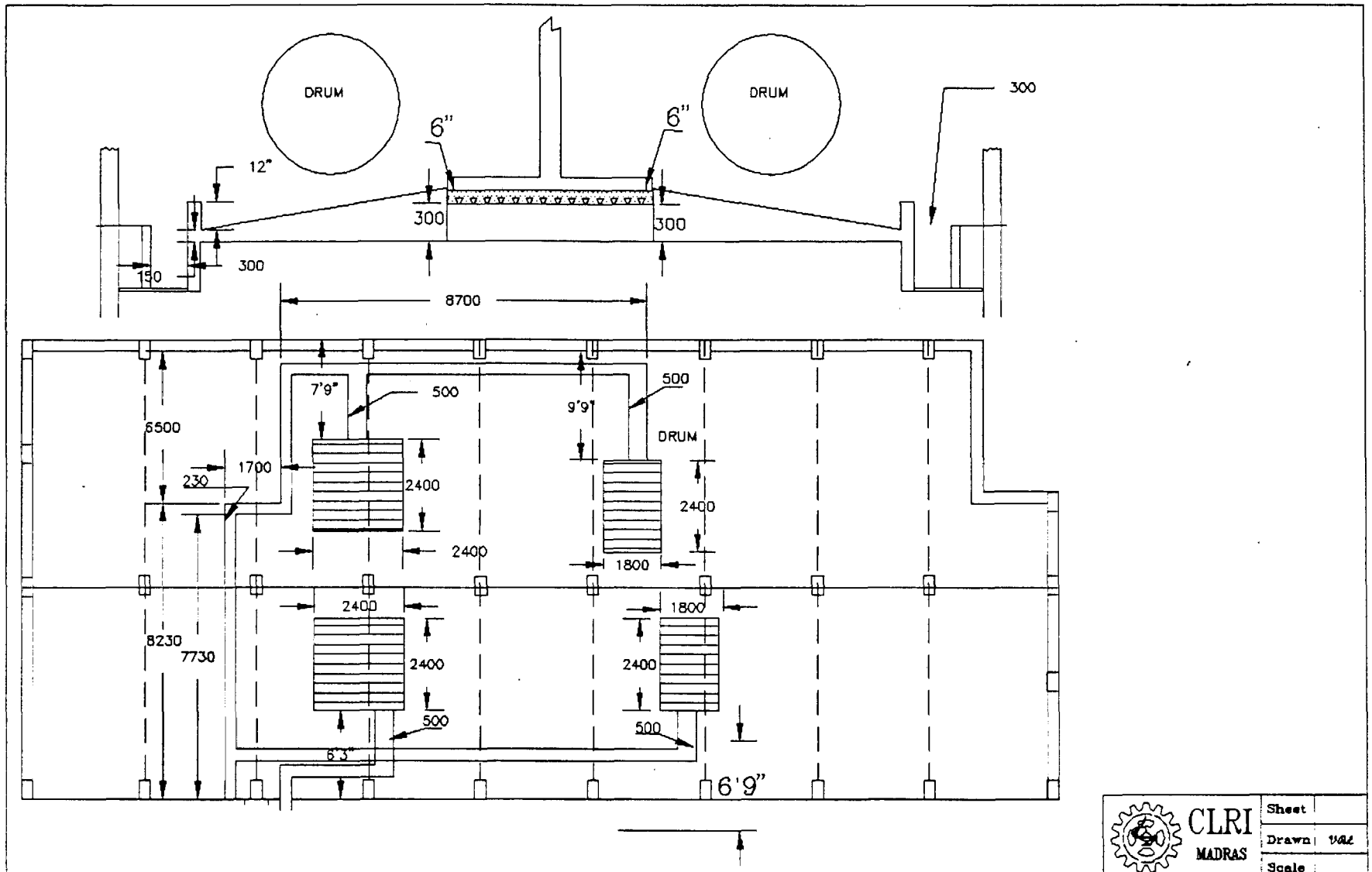

FIG: 4.9 DETAILS OF DRAIN SYSTEM

CLRI MADRAS	Sheet	
	Drawn	VGL
	Scale	
M/S TEJOOMALS TANNERY PERNAMBUT		

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5. PROJECT ENGINEERING ASPECTS

5.1 TURN KEY SUB CONTRACTS

5.1 Turnkey Sub Contracts

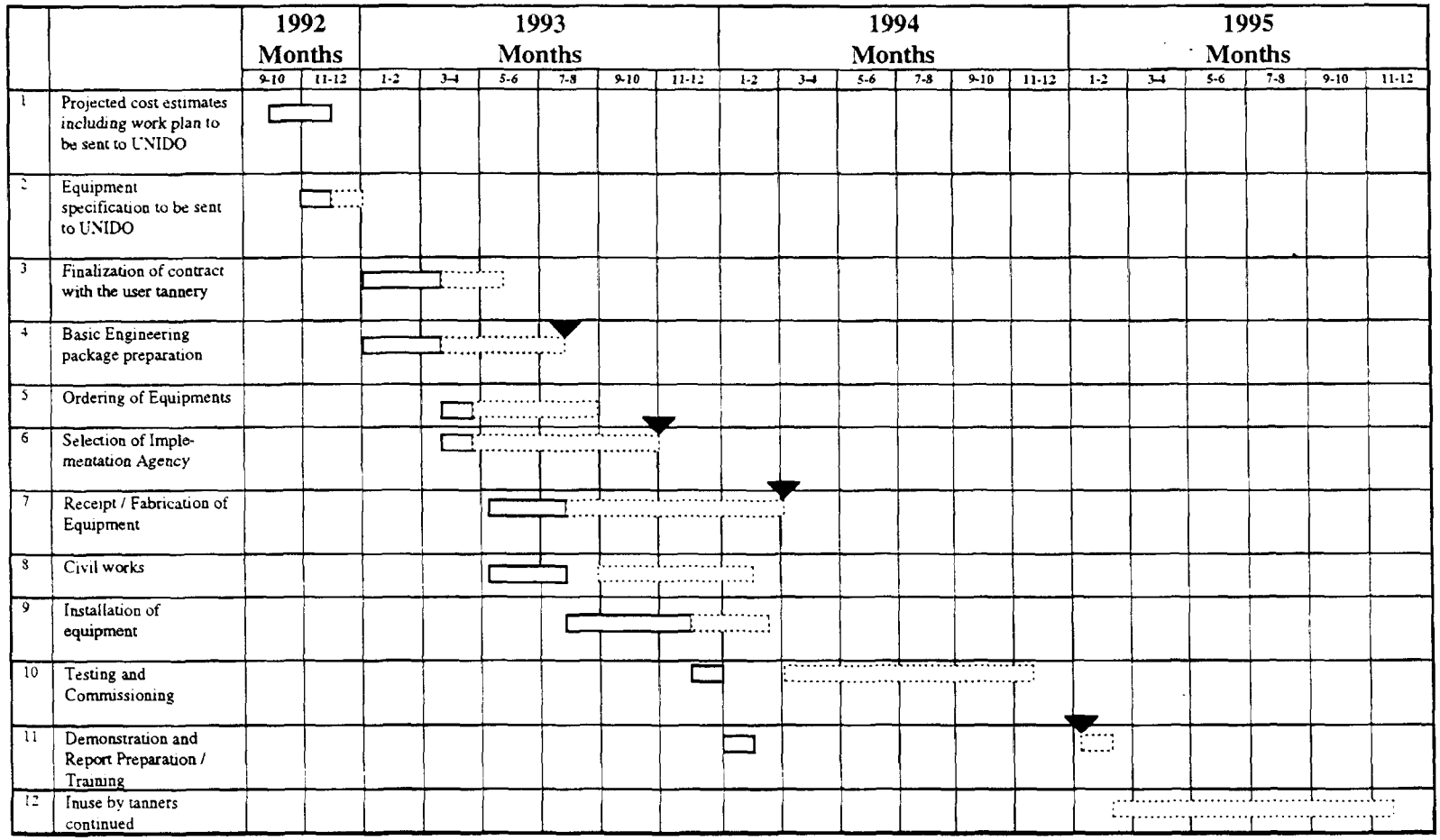
The procurement of major items was carried out by CLRI team, while some of the items like, civil, works, electrical wiring, control room cabin, control module, tank farm, piping and integration jobs were given on sub contract to various firms as given below :

	Item	Name of Firm
1	Civil works & control room cabin	Bharath - Baskar Consusltants Planners & Builders 63/3, Nilyamath Street Pernambut 635 810
2	Electrical installations & wiring	Simson Electrical No.1A, IIIrd Street Srirawapuram Ambur 635 802
3	Control module	Central Electronic & Engineering - Research Institute Taramani Madras 600 113
4	Tank form, piping and overall integration	VEGA Process Equipments 1-3-1036, First Floor Kavadiguda Secunderabad 500 380

The details of item 1- 3 are given in section 4. The details of the item 4, like specifications and terms and conditions of contract are given in **Annexure IV**. CLRI team has carried out the overall coordination for all the four items along with M/s.Tejoomals team.

5.2 TIME SCHEDULES AND IMPORTANT ACTIVITIES

5.2 Time Schedule and Important Activities



5.3 DRY AND WET RUNS

5.3 Dry and Wet Runs

5.3.1 Dry Runs

All major equipments such as CO_2 cylinder manifold, pH meters, float recycle system, chemical weighing system, hot/cold water addition system, bulk chemical storage tanks, intermediate/auxiliary storage tanks, piping, valves and process control module etc., have been installed and dry tested. Details are given in **Table 5.3.1**.

Wet Runs

The main objectives of the wet runs is to test the system (full or partial) under partial or full load conditions employing the process recipes of the conventional and eco-friendly technologies. **Table 5.3.1** provides the details of the seven wet runs carried out so far. In between the wet runs, the personnel of the user tannery were allowed to operate the control system not only to check its operational consistency but also the ability of the personnel to adapt to the new facility. Several faults identified by them were rectified in subsequent dry runs. About 5 to 7 tonnes of hides and skins were processed in wet runs and none of the processed finished leather was rejected by the user tannery.

The wet runs enabled the CLRI team to assess the performance of the following :

i. Water addition system

ii. Chemical automatic weighing system

iii. Pumps and control valves

iv. pH control system

v. Overall micro processor control system

vi. Chemical tank farm

The wet runs on the use of CO_2 for deliming, chrome exhaust aid in chrome tanning and use of high performance syntan in rechroming have been carried out independently. Three deliming batches of cow hides and two batches of buff calf skins have been successfully processed and demonstrated to tannery (typical recipe followed along with variation of flow rate and pH is shown in **Fig.5.3.1**).

The use of polyamide based product for improving the chrome exhaustion during tanning has been successfully demonstrated to the tanner. Two batches of cow hides were processed using this high exhaustion tannage (Typical receipe followed is given **Table 5.3.4**).

Table 5.3.1 : Details of Dry and Wet Runs Prior to Pre-commissioning Trials

Date	Batch No	Nature of Trials	Objectives	Batch Size	Remarks
04.03.94		Dry Run-1	To test chemical tank farm, piping & control instruments/ valves	-	First level debugging completed
07.03.94		Dry Run-2	To test chemical tank farm, piping & control instruments/ valves	-	Second level debugging completed
Control cable laying, electrical works and micro processor system installation undertaken during March/April 1994					
03.05.94 to 10.05.94		Dry Run-3	To test chemical automatic weighing and water pumping system	-	Third level debugging completed
13.06.94	1A	Wet Run-1	CO_2 Deliming	420 kgs (Goad skins)	Material quality satisfactory
14.06.94	2A	Wet Run-2	CO_2 Deliming	800 kgs (Hides)	Partial Success
15.06.94	3A	Wet Run-3	CO_2 Deliming	800 kgs (Hides)	Process restandardization
22.07.94	4A	Wet Run-3	CO_2 Deliming	1000 kgs (Hides)	UNIDO Expert Present; Process Economics to be further studied
23.07.94	5A	Wet Run-5	CO_2 Deliming	520 kgs (Hides)	UNIDO Expert Present; Process Economics to be further studied. Pipe leaks detected
29.07.94		Dry Run-4	To retest pipe leaks and equipment functions	-	Leaks rectified

Table 5.3.1 : Details of Dry and Wet Runs Prior to Pre-commissioning Trials

Date	Batch No	Nature of Trials	Objectives	Batch Size	Remarks
31.07.94 to 02.08.94		Dry Run-5	To calibrate pH control and float circulation systems	-	Calibration work completed
03.08.94 to 04.08.94		Dry Run-5	Training to Process Personnel	-	Training Completed; Metal particles detected in control lines
All equipment thoroughly cleaned and metal particles for welding jobs totally removed and damaged components repaired					
06.09.94		Dry Run-7	Total system thoroughly checked	-	Fourth level debugging completed
From 07.09.94 to 18.09.94, Client's operating personnel allowed to operate control systems for enhancing their ability to operate independently					
19.09.94		Wet Run-6	To study process with all control systems in operation; six batches taken	300-1000	Total system functioned well except for minor leak in float recirculation system; Microprocessor software needed minor adjustments
From 24.09.94 to 16.10.94, The client's operating personnel were allowed to operate the full control system to test the operational consistency of system. Minor problems noted by them were rectified.					
17.10.94 to 18.10.94		Dry Run-7	To test the partially modified software for its adaptability	-	The client has expressed satisfaction with the changes
19.10.94 to 20.10.94		Wet Run-7	To retest the process with modified software	300 kgs (Splits)	Process software worked satisfactorily; Awaiting larger quantity of material for pre-commissioning runs
Pre-commissioning runs (Detailed in **Table 5.3.2 & 5.3.3**) have commenced from 28 October 1994					

Table 5.3.2 : Summary of Pre-commissioning Trial Tuns E-1 to E-3 (28.10.94 to 31.10.94)

Sl. No	Description	Batch - 1		Batch - 2		Batch - 3	
		CON	CAP	CON	CAP	CON	CAP
I	**DELIMING**						
1.	Pelt weight (Kgs)	150	170	190	175	200	200
2.	Washing (%)	100	100	100	100	200X2	200X2
3.	Float (%)	100	100	100	100	100	100
4.	Amm. Salts (%)						
	Amm. Chlo.	1.3	1.3	2.5	1.5	3.0	2.5
	Amm.Sulp.	1.0	1.0	1.0	0.5	1.5	1.5
5.	Bate (%)	0.8	0.8	0.8	0.8	0.8	0.8
6.	Sod. Bisulp (%)	0.2	0.2	0.2	0.2	0.2	0.2
7.	Wetting Agent (%)	0.5	0.5	0.5	0.5	0.5	0.5
8.	Washing (%)	100	100	100	100	100	100
9.	Total time of deliming opr. Upto final washing	3'40"	3'35"	3'30"	3'30"	3'35"	3'50"
II	**PICKLING**						
1.	Float (%)	80	80	80	80	80	80
2.	Salt (%)	8	8	8	8	8	8
3.	Formic Acid (%)	0.2	0.2	0.2	0.2	0.2	0.2
4.	Sulp. Acid (%)	1.2	1.25	1.1	1.1	1.2	1.2
5.	C/S pH*	2.8	2.8	2.8	2.8	2.8	2.8
6.	Bath pH	2.7	2.7	2.6	2.6	2.7	2.6
7.	Time of Pickling (+ left overnight)	2'25"	2'30"	2'30"	2'45"	2'30"	2'30"
III	**CHROME TANNING**						
1.	BCS (%)	8.0	8.0	8.0	8.0	8.0	8.0
2.	Water (%)	100	100	100	100	100	100
3.	SOD. FORMATE (%)	1	1	1	1	1	1
4.	SOD. BICARB (%)	1.8	1.9	2.4	2.1	3.0	3.0
5.	C/S pH	3.8	3.8	3.7	3.7	3.7	3.8
6.	Time	5'50"	5'50"	5'40"	5'40"	5'30"	5'15"

Table 5.3.3 : Pre-commissioning Trials - Further Programmes

Name of the Operation	Remarks	Batch No
Soaking - 100 Hides Soaking	For CO-2 Experiment - I (Cap)	E-4
- 100 Hides	Control for CO-2 expt. I (Man)	C-4
Liming - 100 Hides	For CO-2 Experiment - I (Cap)	E-4
Liming - 100 Hides	Control for CO-2 Expt. I (Man)	C-4
Reliming - 2x100 Hides	Paddles	E-4, C-4
Soaking - 100 Hides	For CO-2 Expt. II (Cap)	E-5
Soaking - 100 Hides	Control for CO-2 + HP Syn (Man)	C-6
Deliming - 100 Hides	CO-2 Expt. I (Cap) in D1	E-4
Pickling - 100 Hides	CO-2 Expt. I (Cap) in D2	E-4
Deliming - 100 Hides	Control for CO-2 Expt. I (Man) in D8	C-4
Pickling - 100 Hides	Control for CO-2 Expt. I (Man) in D8	C-4
Liming - 100 Hides	For CO-2 Expt. Ii (Cap)	E-5
Liming - 100 Hides	Control for CO-2 Expt. II (Man)	C-6
Reliming - 200 Hides	for CO-2 Expt. II (Cap) and	E-5
	Control for CO-2 Expt. II (Man)	C-6
Soaking - 100 Hides	Expt. I (Cap), CO-2 + HP Syn	E-6
Cr. Tan - 100 Hides	CO-2 Expt. I (Cap) in D2	E-4
Cr. Tan - 100 Hides	Control for CO-2 Expt. I (Man) in D8	C-4
Liming - 100 Hides	Expt. I (Cap), CO-2 + HP Syn	E-6
Deliming - 100 Hides	CO-2 Expt. II (Cap) in D1	E-5
Pickling - 100 Hides	CO-2 Expt. II (Cap) in D2	E-5
Deliming - 100 Hides	Control for CO-2 + HP Syn (Man) in D8	C-6
Reliming - 100 Hides	Expt. I (Cap), CO-2 + HP Syn	E-6
Soaking - 100 Hides	Expt. II (Cap), CO-2 + HP Syn	E-7
Assessment of W/B of Expt. I CO-2 Deliming and Control		E-4, C-4
Liming - 100 Hides	Expt. II (Cap), CO-2 + HP Syn	E-7
Deliming - 100 Hides	Expt. I (Cap), CO-2 + HP Syn in D1	E-6
Pickling - 100 Hides	Expt. I (Cap), CO-2 + HP Syn in D2	E-6
Sammying, Deliming Splitting and shaving of W/B of Expt. I, CO-2 and Control		E-4, C-4
Reliming - 100 Hides	Expt. II (Cap), CO-2 + HP Syn	E-7
Cr. Tan - 100 Hides	Expt. I (Ca;), CO-2 + HP Syn in D2	E-6
Recr. Neut - 2x100 Hides	Expt. (Cap), CO-2 in D3	E-4
Dye, Fat	Control for CO-2 in D4	C-4
Assessment of W/B CO-2 Expt. II and Control of CO-2 + HP Syn		E-5, C-6

Table 5.3.3 : Pre-commissioning Trials - Further Progress Programme of II Phase Trial Runs (Contd...)

Name of the Operation	Remarks	Batch No
Deliming - 100 Hides	Expt. II (Cap), CO-2 + HP Syn in D1	E-7
Pickling - 100 Hides	Expt. II (Cap), CO-2 + HP Syn in D2	E-7
Sammying, Splitting and shaving of CO-2 Expt. II, CO-2 + HP Syn and Control		E-7, C-6
Setting and Drying of Expt. I, CO-2 and Control Lots		E-4, C-4
Cr. Tan - 100 Hides	Expt. Ii (Cap), CO-2 + HP Syn in D2	E-7
Re-Cr, Nuet - 100 Hides	Expt. II (Cap), CO-2 + HP Syn in D3	E-7
Dye, Fat	Control for CO-2 + HP Syn in D4	C-6
Assessment of W/B Expt. I, CO-2 + HP Syntans		E-6
Staking, Trimming, Buffing, De-Dusting of Expt. I, CO-2 and Control		E-4, C-4
Sammying, Splitting and Shaving of Expt. I, CO-2 + HP Syntans		E-6
Setting and Drying of Expt. II, CO-2 and Control of CO-2 + HP Syntans		E-7, C-6
Recr, Neut - 100 Hides Dye, Fat	Expt. I (Cap), CO-2 + HP Syn in D3	E-6
Assessment of W/B of Expt. II, CO-2 + HP Syntans		E-7
Sammying, Splitting and Shaving of W/B of Expt. II CO-2 + HP Syntans		E-7
Setting and Drying of W/B of Expt. I, CO-2 + HP Syntans		E-6
Recr, Nuet - 100 Hides Dye, Fat	Expt. II (Cap), CO-2 + HP Syn D3	E-7
Staking, Buffing of Expt. I, CO-2 + HP Syntan and Assessment		E-6
Setting, Drying of Expt. II, CO-2 + HP Syntans		E-7
Drying of Expt. II, CO-2 + HP Syntans Treated Leathers		E-7
Staking, Buffing and Assessment of Expt. II CO-2 + HP Syntans Treated Leathers		E-7

Batch No	Description
C-4	Ammonia Salts + Manual Additions and Operations
E-4	CO-2 Deliming + Process Control Systems
E-5	CO-2 Deliming + Process Control Systems
C-6	Ammonium Salts + Manual Additions and Operations
E-6	CO-2 Deliming + HP Syntans + Process Control Systems
E-7	CO-2 Deliming + HP Syntans + Process Control Systems

Table 5.3.4 : High Exhaustion Tannage

Pickling and Tanning Trials At CLRI

Raw Material : Delimed and bated cow hides

Water	150 %	}	
		}	30'
Wetting agent	0.5%	}	
	Drain		
Water	80%	}	
		}	10'
Salt	8%	}	
Sodium formate	0.5%	}	10'
Formic acid	0.2%	}	10'
Sulfuric acid	1.0%	}	6 x 10' + 30'
+ Formic acid	0.3%	}	2 x 15'
	Left Overnight		
	Next day, drain half batch		
BCS	4%	}	30'
Polyamide exhaust aid		}	20'
BCS	4%	}	60'
	Left in bath for ageing for 120'		
+ Sodium format	0.5%	}	30'
+ Sodium bicarbonate	20%	}	6 x 5' + 30
+ Preservative	0.25%	}	30'
	Drain - Wash - Pile		

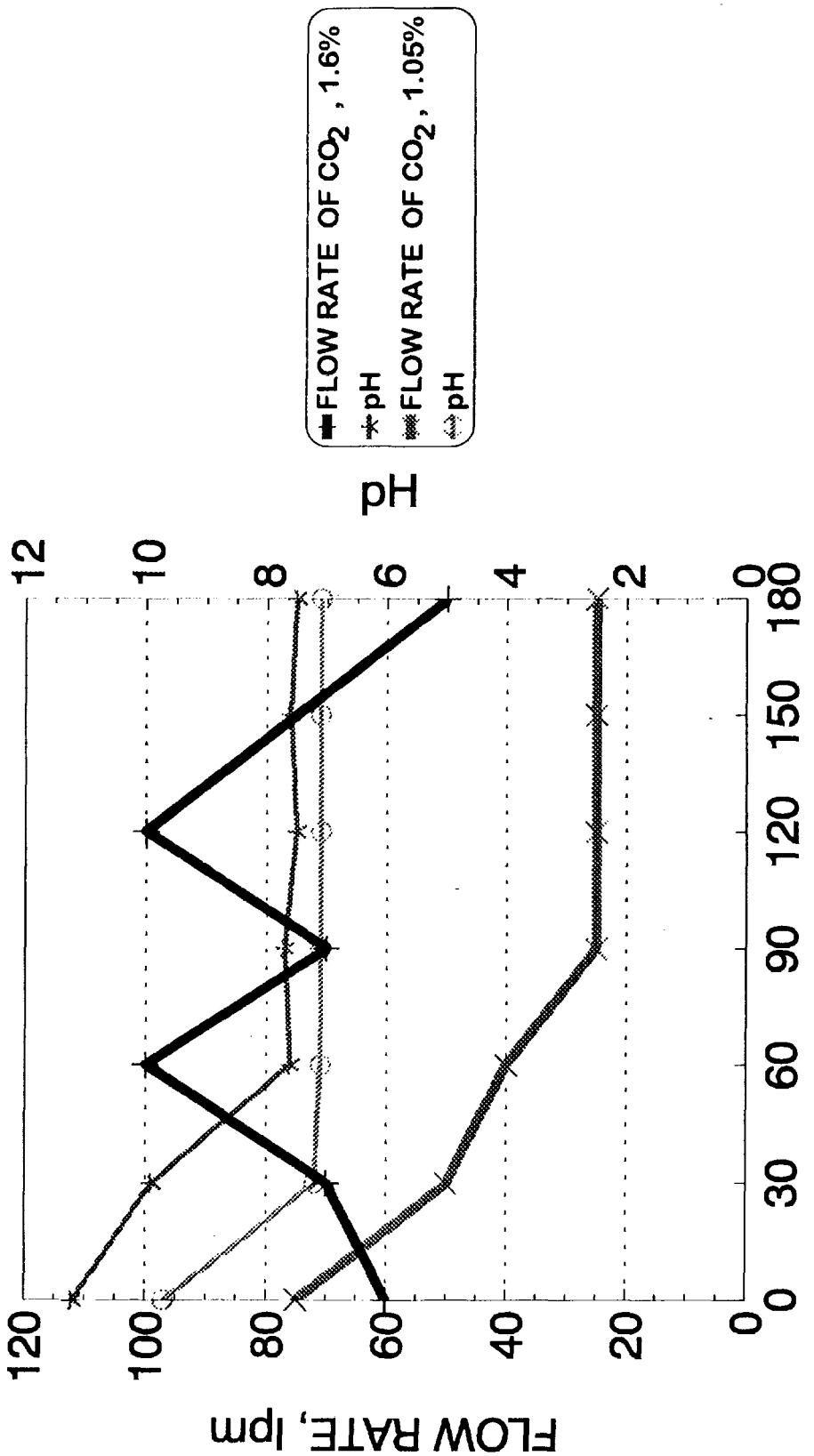


Fig: 5.3.1 CARBON DIOXIDE DELIMING OF COW SIDES

5.4 COMMERCIAL SCALE TRIALS

5.4 Commercial Scale Trials

On successful completion of wet runs commercial scale trials were carried out using the system. More than 10 batches of heavy cow hides were processed using all the modules of cleaner technology package. The spent liquor of the various operations were analysed and compared with conventional processing system. The crust leathers were assessed for physical and functional properties both by visual assessment and using analytical tools. Typical receipes followed are given below and salient features of experiment are given in **Table 5.4.1**. Table **5.4.2, 5.4.3 and Fig.5.4.1** indicate the results of these trials.

5.4.1 Deliming and bating

Limed and fleshed Pelts were weighed and loaded in the drum and washed with water for a duration of 10 minutes. (All Percentages based on pelt wt). The pelts were drummed with 150% water and carbon-di-oxide was let in at the rate of 1001 pm for 15 minutes. Then 1% Bate was added and drumming continued at the same gas flow rate until a buffering pH of 7.0 was reached. The carbon-di-oxide flow rate was then reduced to 501 pm and drumming continued for a further period of 90 minutes. Completion of deliming was checked by using phenolphthalein. Conventional processing involved use of ammonium salts (both chloride & sulfate in the ratio 1:1) for deliming, at the end of which Bate was added & drummed, unlike in the ammonia free deliming where bate was

added at the beginning of deliming itself. **Table 5.4.2** brings out the salient features of ammonia - free deliming in comparison with conventional deliming.

5.4.2 Pickling

The Delimed and bated pelts are then pickled by continuous addition of acid through chemical addition system coupled with pH controller. The addition of acid continued up to attainment of equilibrium pH 2.8 - 3.0 which was completed in 90 minutes. In the conventional processing the pelts were pickled by adding acid manually in 6 feeds of 15 minutes interval.

5.4.3 Tanning

The picked pelts were treated with 4% Basic Chromium sulfate (BCS) and drummed for 30 minutes. Then 1% Polyamide based chrome exhaust aid was added and drumming continued for 30 more minutes. The second installment of 4% BCS was then added to the drum which was run for a further period of 30 minutes, before basification of the tanning batch commenced. Similar to pickling, the alkali (sodium formate & sodium bicarbonate (1:)) required for basification was added continuously over a period of 60 minutes. The addition of alkali continued up to attainment of equilibrium pH of 3.8 - 4.0. In the conventional processing, 8%, BCS was added in two feeds of 30 minutes interval. After checking completion of penetration, the tanning bath was basified using sodium formate and sodium bicarbonate (1:1 ratio) added in 8 feeds of 10 minutes interval. The

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wet blue leathers after piling overnight were tanned, split and shaved and then taken for post tanning operations.

5.4.5 Rechroming (All percentages are based on shaved weight)

The Wet blue leathers were rechromed using 3% of High performance syntan and 2% BCS and basified by adding alkali continuously similarly to pickling and tanning. In the case of conventional processing 5% of BCS was used for rechroming and basified by adding alkali manually.

5.4.6 Neutralization, Retanning, Dyeing, Fatliquoring

The rechromed leathers were neutralized by adding alkali continuously over a period of 90 minutes to obtain an equilibrium pH of 5.0. In Retanning, dyeing and fatliquoring operations, the chemical dosing and water addition systems were used for maintaining proper hide - float ratio and concentration of chemicals in the case of eco-friendly system. In the conventional system all these operations were carried out manually. The spent liquors of eco-friendly system and conventional system have been collected and analysed. Trials are carried out for checking the consistency of results. The effluent characteristics of integrated eco-friendly system carried out is given **Table 5.4.3.**

5.4.7 Observations

wet blue leathers after piling overnight were tanned, split and shaved and then taken for post tanning operations.

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Table 5.4.1 : Experimental Details

	Control	Experiment I	Experiment II
Washing	Water 200% (15 minutes)		
Deliming	Water 150% Ammonium sulfate 0.5% Ammonium chloride 0.5% (2 hours) Ammonium sulfate 0.5% + Bate 1.0% (45 minutes) Ammonium Sulfate 0.5% (1 hour)	Water 150% Bate 1% (15 minutes) CO_2 1.5% (4 hours)	Water 150% Bate 1% CO_2 2.2% (3.5 hours)
	50% bath drained		
	Water 50% + Ammonium sulfate 0.5% (60 minutes)		
Washing	Wetting agent 0.5% (20 minutes) Water 200% (10 minutes)		
	Drain and left overnight		
Pickling	Water 80% Salt 8% (20 minutes) Formic acid 0.5% (30 minutes) pH 5.0 Sulphuric acid 1.0 % (65 minutes) pH 4.5	Water 80% and Salt 8% pH 8.0 Formic acid 0.4% (20 minutes) Formic acid 0.4% (30 minutes) pH 6.5 Sulphuric acid 1% (60 minutes) pH 4.0 Left Overnight Formic acid 0.1% pH 4.0 (40 minutes) Formic acid 0.1% (30 minutes) pH 3.8 Formic acid 0.1% (60 minutes) pH 3.5	Water 80% pH 7.3 Salt 8% pH 7.3 Formic acid 1% pH 7.0 (120 minutes) Sulphuric acid 1% pH 4.0 (135 minutes) Overnight Formic acid 0.2% pH 3.5 (20 minutes) Formic acid 0.1% 3.0 (85 minutes) Formic acid 0.1% pH 3.0 (60 minutes)
	Left Overnight		
Chrome Tanning	Formic acid 0.1% (90 minutes) pH 4.0 Formic acid 0.2% (60 minutes) pH 3.5 Formic acid 0.1% (90 minutes) pH 3.0 Tergolix 'A' 0.2% (10 minutes) BCS 4.0% (10 minutes) Cationic fatliquor 0.5% (20 minutes) BSC 4% Sodium formate 0.5% (5 hours) + Sodium format 0.5% (45 minutes) + Sodium Bicarbonate 2.0% slowly added for 2 hours and sum for another 2 hours	Tergolix 'A' 0.2% pH 8.0 BCS 4% (10 minutes) Cati-fatliquor 0.5% (20 minutes) Tuftan 1% BCS 4% (285 minutes) Sodium Formate 0.5% (30 minutes) Sodium bicarbonate 2% (240 minutes)	Tergolix 'A' 0.2% (125 minutes) BCS 4% (10 minutes) Cationic fatliquor 0.5% Tuftan 1% (5 minutes) BCS 4% Sodium formate 0.5% (90 minutes) Water 25% Sodium formate 1% (30 minutes) Water 25% (120 minutes)
	Left overnight & filed	Left overnight & filed next day	Left overnight and filed

Table 5.4.2 : Deliming Spent Liquor Analysis

	Ammonia free cleaner processing	Conventional processing
pH	7.14	8.17
Alkalinity	2000	3200
BOD	1380	2100
COD	2446	4170
Total solids	9965	23195
Chloride	1357	5557
Sulfate	1284	3942
Ammonia	514	1856

All the parameters except pH are expressed in mg/l

Table 5.4.3 : Spent Liquor Analysis (Raw to Wet Blue Composite)

	Ammonia free cleaner processing	Conventional processing
pH	10.13	10.35
Alkalinity	1800	2400
Total solids	25240	28020
Chloride	5922	7402
Sulfate	1069	1530
Ammonia	84	169
Chrome	534	702

All the parameters except pH are expressed in mg/l

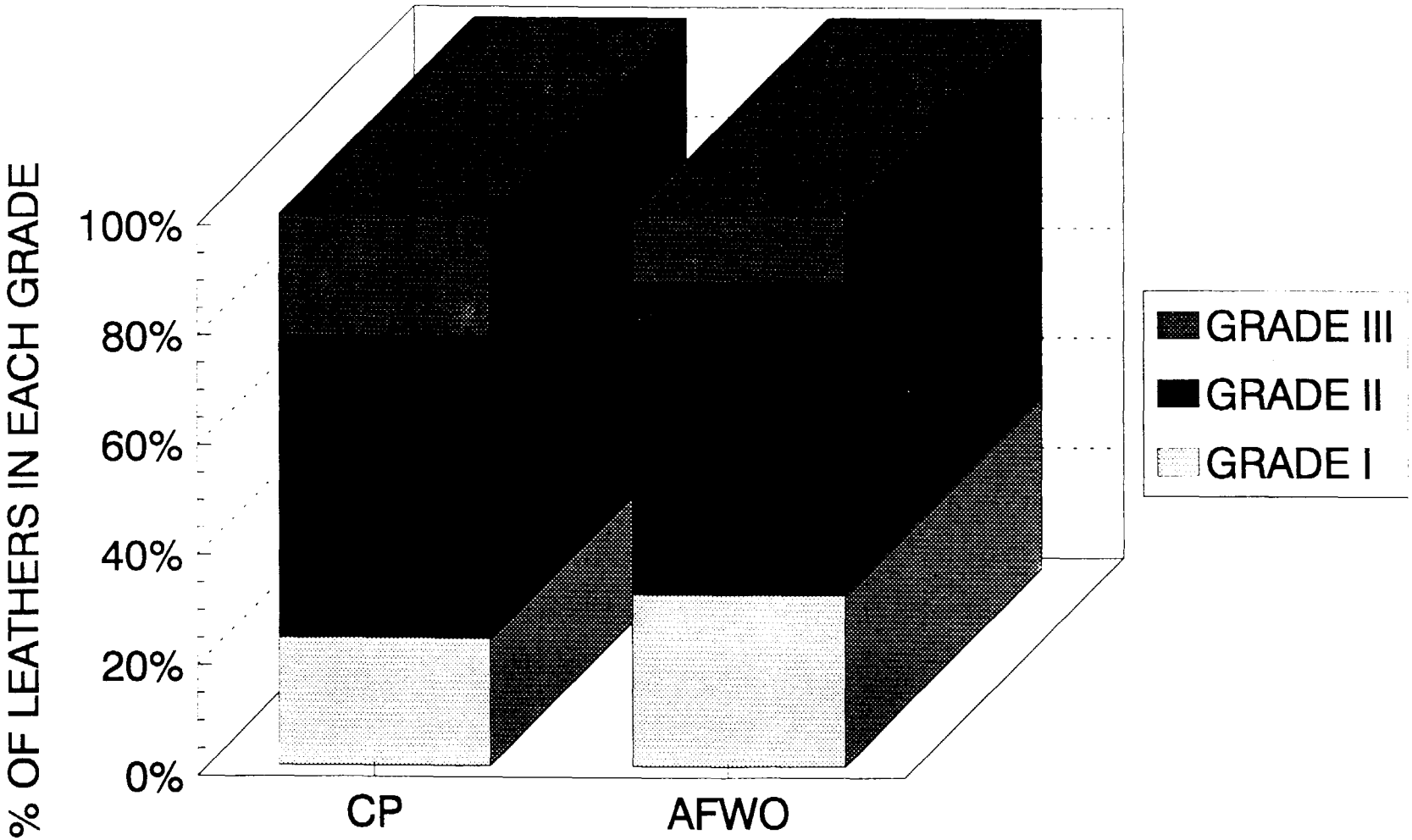


Fig: 5.4.1 COMPARISON OF QUALITY OF FINISHED LEATHERS

AFWO : AMMONIA FREE CLEANER WET OPERATIONS
CP : CONVENTIONAL PROCESSING

5.5 PROGRAMME REVIEW BY EXPERTS

5.5 PROGRESS REVIEW BY EXPERTS

5.5.1. UNIDO chief technical adviser (CTA)

Dr.Z. Kotazek, UNIDO chief Technical Adviser along with special task force of CLRI visited number of Tanneries for implementation of Ammonia Free cleaner wet Tanning Operation project. The Task force along with CTA finally decided to implement the project at M/s Tejoomal Industries Limited. Frequent meetings were held by CTA with CLRI Task force to review the progress of implementation of the project.

Dr. Z. Kotazek visited M/s Tejoomal's Industries Limited along with Dr. K.V.Raghavan Director, CLRI on 29.10.94 to monitor the progress of Pre-Commissioning trials. Dr. Kotazek held detailed discussions with CLRI Team & user tannery about the trials and instructions to be followed by the user while operating the system. The operating staff of the user tannery demonstrated their capability to independently handle the microprocessor system Chemical tank farm, Chemical & water addition units & pH control system.

5.5.2. UNIDO Project Officer

Mr. J. Buljan, the project officer, UNIDO visited CLRI, Madras on 15th & 16th July 1993. He held detailed technical discussions with the CLRI project team pertaining to implementation of the project. He visited M/s Tejoomal Industries Limited to assess the site conditions and technical capabilities of the tannery personnel for absorbing the technology.

Mr. J. Buljan & his team visited CLRI Madras again in the month of February 1994 and held detailed discussions with the project team & reviewed the progress.

Mr. Buljan visited CLRI in January 1995 to participate in LERIG where a joint presentation of CLRI & user tannery on the results of implementation of the project was made. Mr. Buljan appreciated the progress made in the project.

5.5.3. UNIDO Expert Visit

A) First Visit :-

Prof.K.H. Munz visited CLRI from 20th to 30th July 1993. He held extensive scientific discussions with the CLRI project team on Co_2 deliming.

CLRI project team arranged Co_2 deliming technology demonstrations from 26th to 29th July 1993 at CLRI pilot tannery. Prof. Munz participated in the demonstrations & explained the advantages to the tanners who attended the meeting.

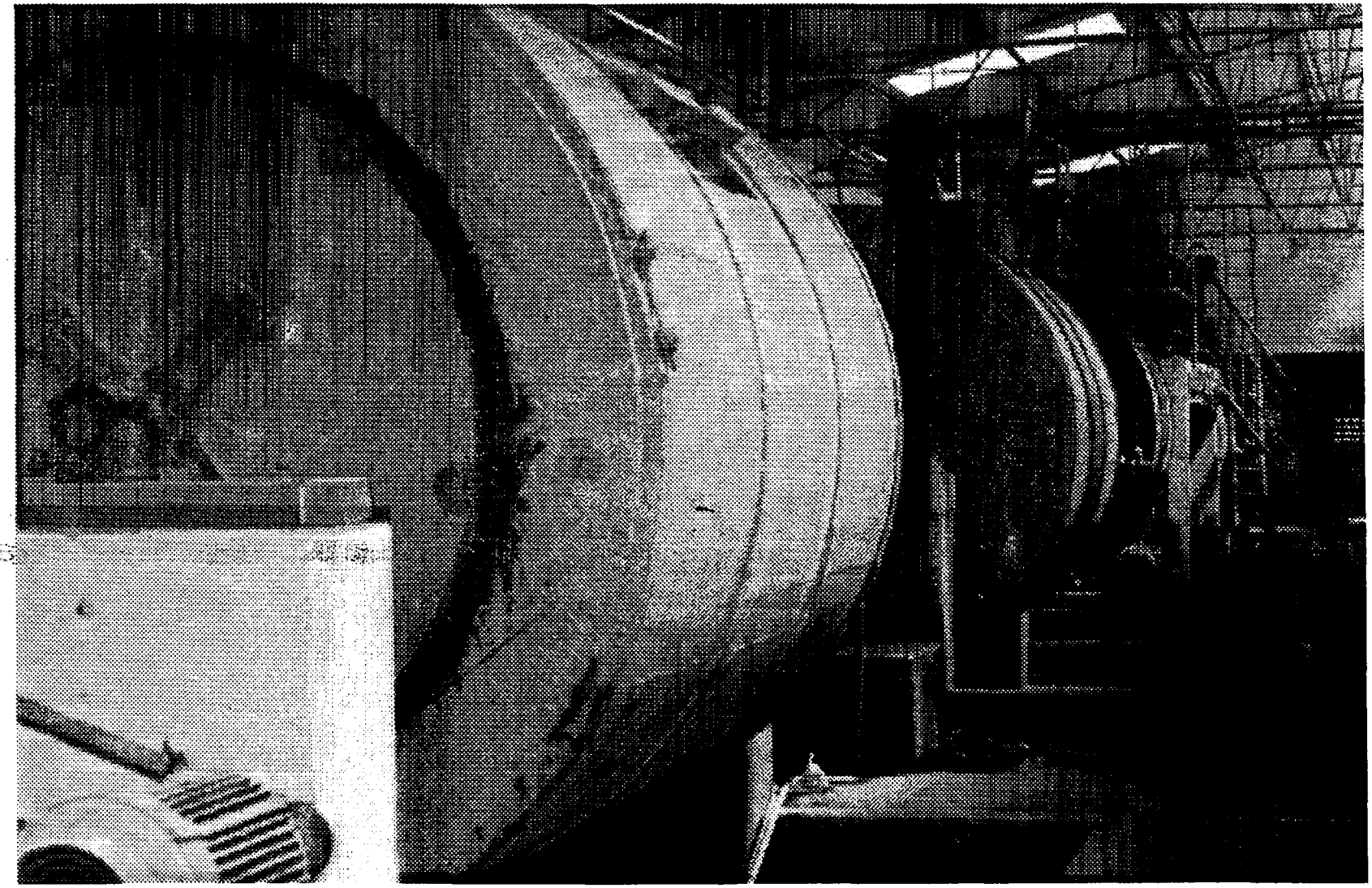
2nd Visit:-

Prof. Munz visited CLRI again in April 1994 to carry pilot scale trial on Co_2 deliming along with CLRI team at M/s Tejoomal Industries Limited. He also carried out pickle free chrome tanning trials at CLRI.

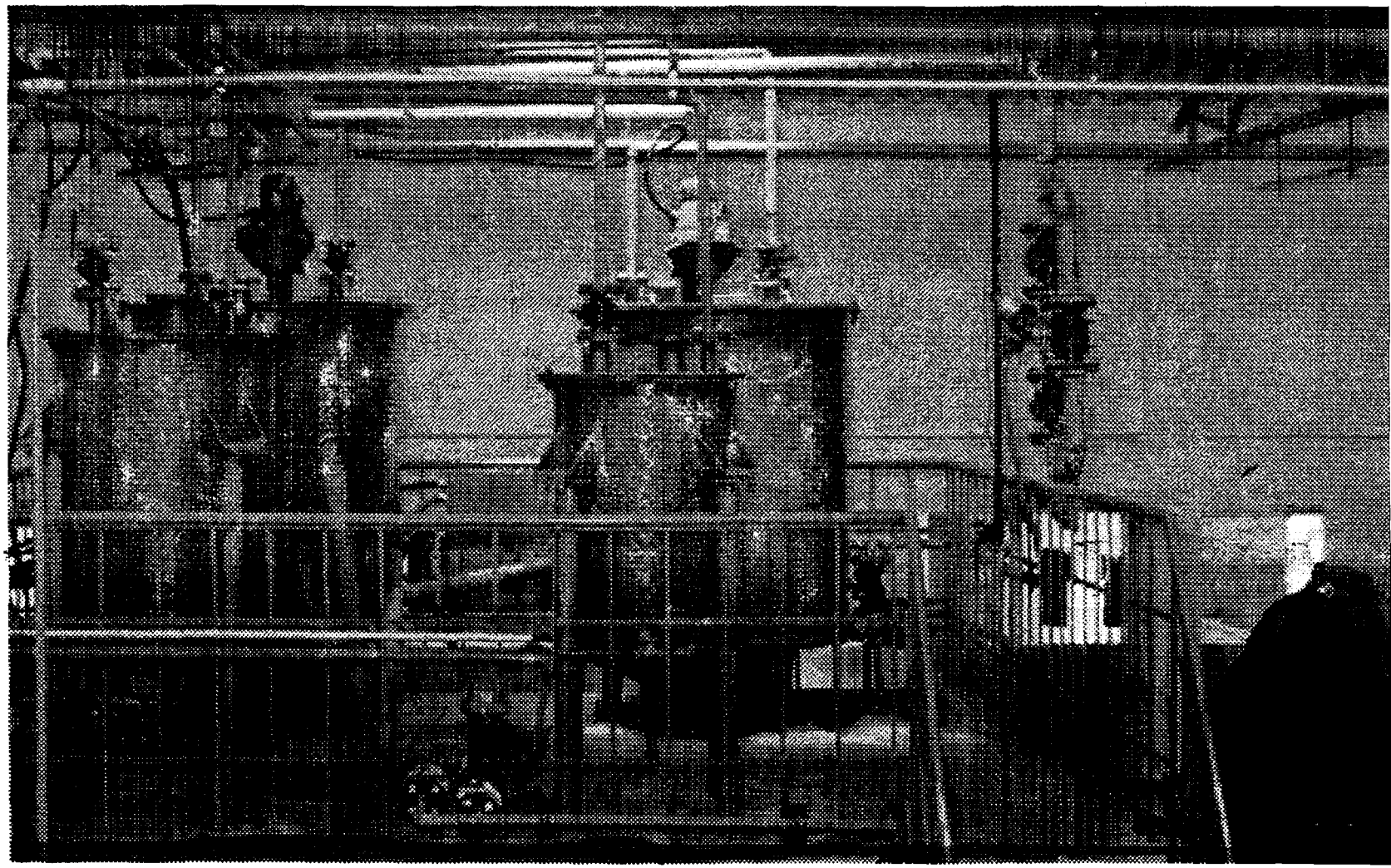
Prof. K.H. Munz visited, along with CLRI team, M/s Tejoomal Industries Limited to participate in the Commercial trials carried out using Co_2 for deliming & control systems for other unit operations in July 1995. He also carried out trials at CLRI on pickle free tanning. The technical report of Prof. K.H.Munz with his recommendations is given in **Annexure-V.**

5.6 PHOTOGRAPHIC VIEWS OF TEJOOMAL'S TANNERY

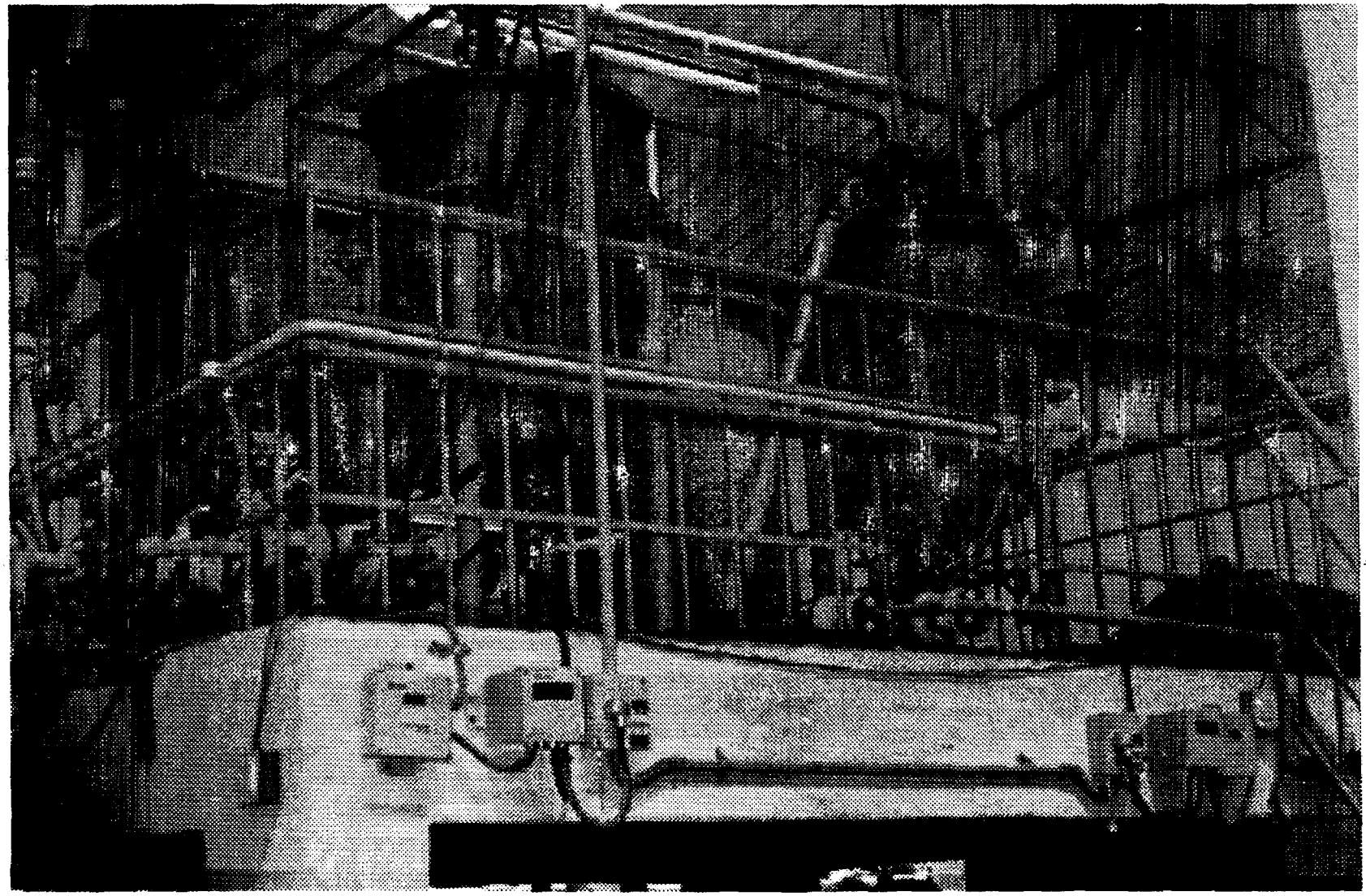
A VIEW OF DRUM YARD WITH DRAINAGE FACILITIES



A VIEW OF CHEMICAL FEEDING BATCH TANKS ON PLATFORM

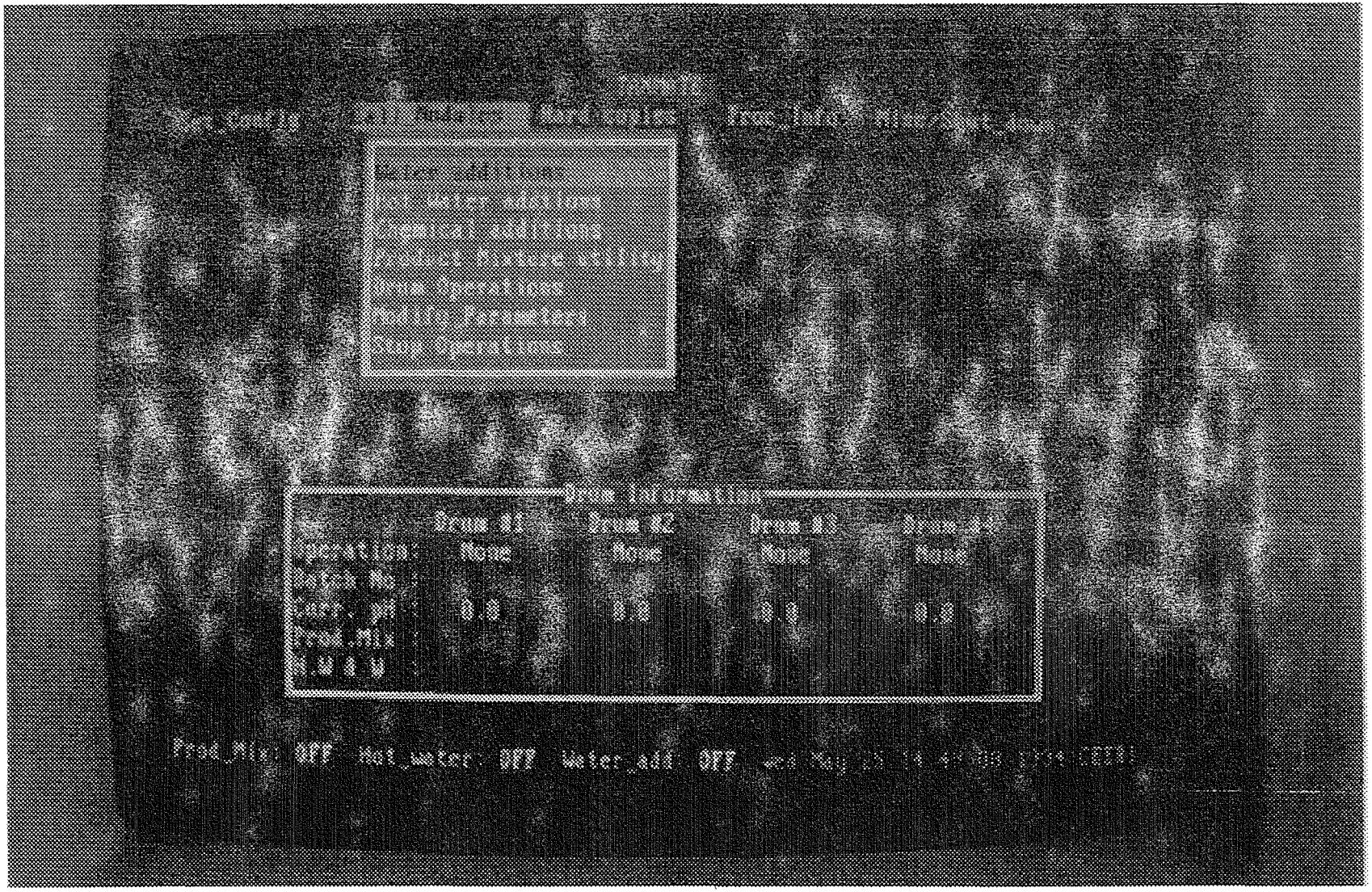


A VIEW OF CHEMICAL FEEDING TANKS WITH pH INDICATORS



DISCUSSION WITH THE UNIDO EXPERT

VIEW OF MONITOR SCREEN FOR CONTROL



6. TRAINING OF PERSONNEL

6.1 Training of User Tannery Personnel

An introductory training programme on operation of CO_2 deliming, instrument control system for water and chemical addition, pH control and monitoring was given to two tannery staff members of M/s.Tejoomals from 13.12.1993 to 17.12.1993 at CLRI and at M/s.Tejoomals Tannery from March 1994 onwards till October 1995. The training has covered ten following main aspects.

- Handling of Eco-friendly systems including Carbon-di-oxide gas, process control measures etc.
- Safe handling of chemicals
- Operation and maintenance of all the equipments
- Time sequence of unit operations

Equipment suppliers were closely involved in rectifying the minor teething problems during the wet and dry runs. M/s.VEGA Process Equipment (Engineering firm for the work of implementation) attended to the leaks and minor modifications in the piping/pumps. M/s.Avcon Control Engineers and M/s.Navbharath Engineers (valve and pump suppliers) visited the site at regular intervals to rectify the identified defects. These firms also provided training on operation and maintenance of control valves, pH meters, pumps and compressors respectively to the maintenance staff of M/s.Tejoomals. Training on microprocessor usage for process control and data logging and the operation of CO_2 deliming process have also been provided to the client by the Madras centre of CEERI.

deliming process have also been provided to the client by the Madras centre of CEERI. The unit also sent its computer experts from time to time to remove the software and hardware bottlenecks. The user tannery had appointed two qualified engineers to look after the control systems.

The CLRI team prepared Demonstration Data Sheets for compiling techno-economic information during pre-commissioning runs. The operating personnel of the user tannery were trained in data compilation and the operational sequences to be followed in the cleaner technologies. Messrs Sudhakar and Ravichandra, Production Managers of the user tannery were closely associated in all the activities pertaining to batch planning, monitoring, operational data collection and interpretation of the results. They have shown tremendous enthusiasm in carrying out their responsibilities. The overall success achieved in this programme, to a large extent goes to the management staff of the user tannery.

7. PROCESS DEMONSTRATION REPORT

7. Process Demonstration

7.1 Two batches of deliming, pickling and chrome tanning of cow hides were carried out. One batch was processed in the conventional way to compare with the other processed using Ammonia free process control system. It was observed that deliming could be effectively carried with carbon-di-oxide and the leathers were comparable to conventionally processed leathers.

7.2 Two batches of EI Buff calf skins were processed in to terra-cotta. One batch was processed by conventional method and the other using control system. It was observed that nearly 20% of retanning material could be saved when control system was used for processing without any adverse effect on leather.

7.3 One set of experiments were carried out on cow hides flow wet blue to existing

The experimental details are provided in **Table 7.1, 7.2 and 7.3**. The physical test data and visual assessment data of leathers processed as per the above experiment were compared and the quality of leathers processed with CO_2 deliming and process control system were found to be better. The results are shown in **Fig.7.1 & 7.2**.

Table 7.1 : Experiments with cow hides for comparison of processing with conventional scheme and ammonia free & process control system

	Control	Experiment I
Washing	Water 200% (15 minutes)	
Deliming	Water 50% Ammonium sulfate 0.75% Ammonium chloride 0.75% Bate 0.20% (4 hours) + Ammonium sulphate 1.0% (60 min) + Bate 1.0% (40 minutes) + Water 100% (20 minutes)	Water 50% Bate 1% CO_2 2% (4 hours)
Washing	Wetting agent 1.0% (50 minutes) + Water 100%	
Pickling	Water 80% Salt 8% (15 minutes) + Formic acid 1.0% (4 hours) + Sulfuric acid 1.0% Left overnight	Water 2% Salt 8% (15 min) Formic acid 1% (240 min) Sulfuric acid 1.3% (60 min+overnight)
Next Day	+ Sulfuric acid 0.3% (2 hours), pH 2.7	Formic acid 0.2% pH 2.8
Chrome Tanning	+ Dispersing agent 0.2% (10 min) + BCS 4.0%(10 min) + Cationic fatliquor 0.5% (25 min) + BCS 4.0% Sodium formate 0.5% (4 hours) + Water 25% Sodium formate 0.5% (30 min) + Sodium bicarb 2% (90 min) pH 4.0	Dispersing agent 0.2% BCS 4% Cationic fatliquor 0.5% Tuftan 1% BCS 4% Sodium formate 0.5% Sodium Formate 0.5% Sodium bicarbonate 2%
	Piled	

Table 7.2 : Experiments with EI buff calf skis for processing in conventional scheme and process control scheme

	Control	Experiment I
Stripping	Water 200% Degresol 1% Sodium sulphite 1% Sodium bicarb 0.5% Wetting agent 0.5% (60 minutes)	Water 200% Degresol EI 1% Sodium sulphite 1% Sodium bicarb 0.5% Wetting Agent 0.5% (60 min)
Souring	Water 200% Oxalic acid 0.5% NBEM 0.5% (30 minutes)	Water 200% Oxalic acid 0.5% NBEM 0.5% (30 min)
Washing	Water 150% (15 minutes)	Water 150% (15 min)
Neutralization	Water 200% Sodium formate 1% Sodium bicarb 1% pH 5-5.3	Water 200% Sodium formate 1% Sodium bicarb 1% pH 5-5.3
	Drained	Drained
Washing	Water 150% (15 minutes)	Water 150% (15 min)
Dyeing, retanning & fatliquoring	Hot water 200% fibropal MO 1% (10 min) + GS Powder 3% (20 min) +Retan FB 2% Syntan ZN 2% Syntan AC 2% (45 min) + Derma orange 2G 0.2% Derma yellow 2G 0.1% Derma pink 0.015% (30 min) Fibropal MO 2% Lipor NTR 2% Lipor RNRS 2% Softafin 2% Softafin 3% Lipor LN 2% Fibropal LA 2% + Retan FB 1% + GS powder 1% (20 min) + Dye (30 min) + II fatliquor (30 min) + Formic acid 1% (21 min)	Hot water 200% Fibropal MO 1% (10 min) + GS Powder 3% + Retan FB 2% Syntan ZN 2% Syntan AC 1% (45 min) + Derma Orange 2G 2% Derma yellow 2G 1% (30 min) Derma pink 0.015% + Fibropal Mo 2% Lipor NTR 2% Lipor RNFS 2% Softafin 3% (45 min) Lipor LNW 2% Fibropal LA 2% + GS powder (2 min) Dye (30 min) + II fatliquor 30 min + Formic acid 1%
	Drain	Drained
	Water 150% Waxofin 0.5% (10 min)	Water 150% Waxofan 0.5% (10 min)
	Drained & Piled	Drained & Piled

Table 7.3 : Experiments with cow sides from wet blue to crusting

	Control	Experiment I
Rechroming	Water 10% BCS 2% Sodium formate 0.25% (20 min) + Lipor KAT 0.5% (10 min) + Orotan 540 1.5% Tergotan As 1.5% Retan LSI 2% (20 min) + BCS 2% Sodium formate 0.25% (30 min) + Water 100% (30 min) Sodium formate 0.5% (10 min) Sodium bicarbonate 1% (75 min) pH 3.8	Water 10% BCS 2% Sodium formate 0.25% (30 min) + Lipor KAT 0.5% (10 min) + Orotan 540 1.5% Tergotan AS 1.5% Retan LSI 2% (20 min) + BCS 2% Sodium formate 0.25% (30 min) + Water 100% (30 min) Sodium formate 0.5% (15 min) Sodium bicarbonate 1% (30 min) Water 10% (30 min) pH 3.5
	Drained	Drained
Washing	100% (10 min)	Water 100% (10 min)
Neutralisation	Water 150% Vernol AKM 1% (45 min) pH 4.8	Water 150% (35 min) Vernatan AKM 1% (30 min) pH 4.5
Washing	Water 100% (10 min)	Water 100 % (10 min)
Fatliquoring	Water 100% Vernol liquors 2% Ingrassnate S 126 1% RNFS 2% (20 min)	Water 100% Cilisor S 2% Ingrassanate S 126 1% RNFS 2% (20 min)
Dyeing	+ Pink dye 0.1% (5 min)	+ Pink dye 0.1% (5 min)
Retanning	+ RL 4% Relugen RE 3% Basyntan DI 3% Basyntan AN 2% (30 min)	+ RL 4% Relugen RE 3% Basyntan Di 3% Basyntan AN 2% (30 min)
Fatliquoring	+ Vernol Liquor 2% Ingressnate S 126 1% MO 1% (30 min)	+ Vernol liquor S 2% Ingrassanate S 126 1% (30 min)
Dyeing	+ Formic acid 1% (40 min)	
Top retanning	+ Basyrtan DI 1% (20 min)	+ Basyntan DI 1% (15 min)
Fixing		+ Formic acid 1% (20 min)
	Drained & piled overnight	

Fig: 7.1 VISUAL ASSESSMENT OF DYED CRUST LEATHERS

(COMMERCIAL SCALE EXPERIMENTS)

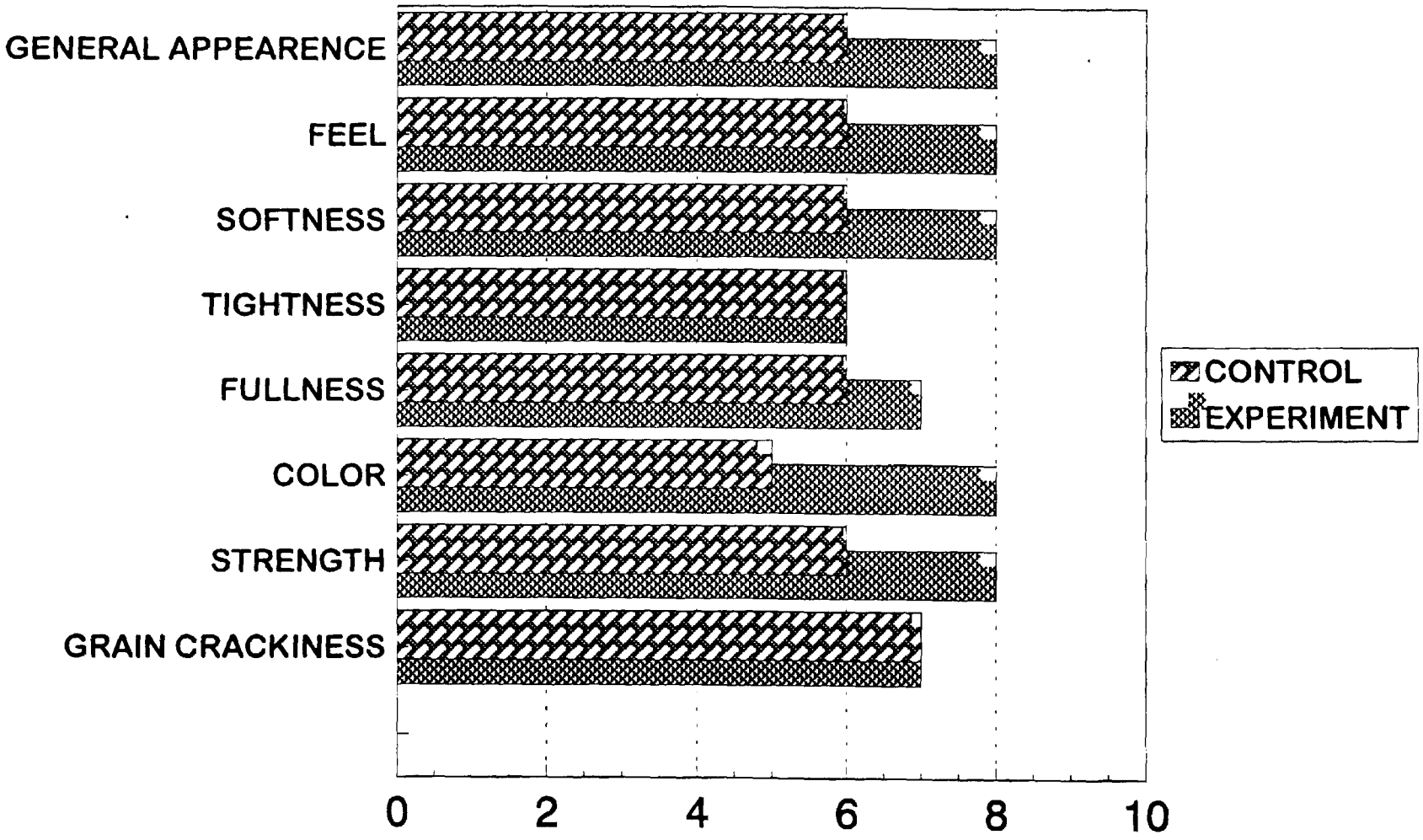
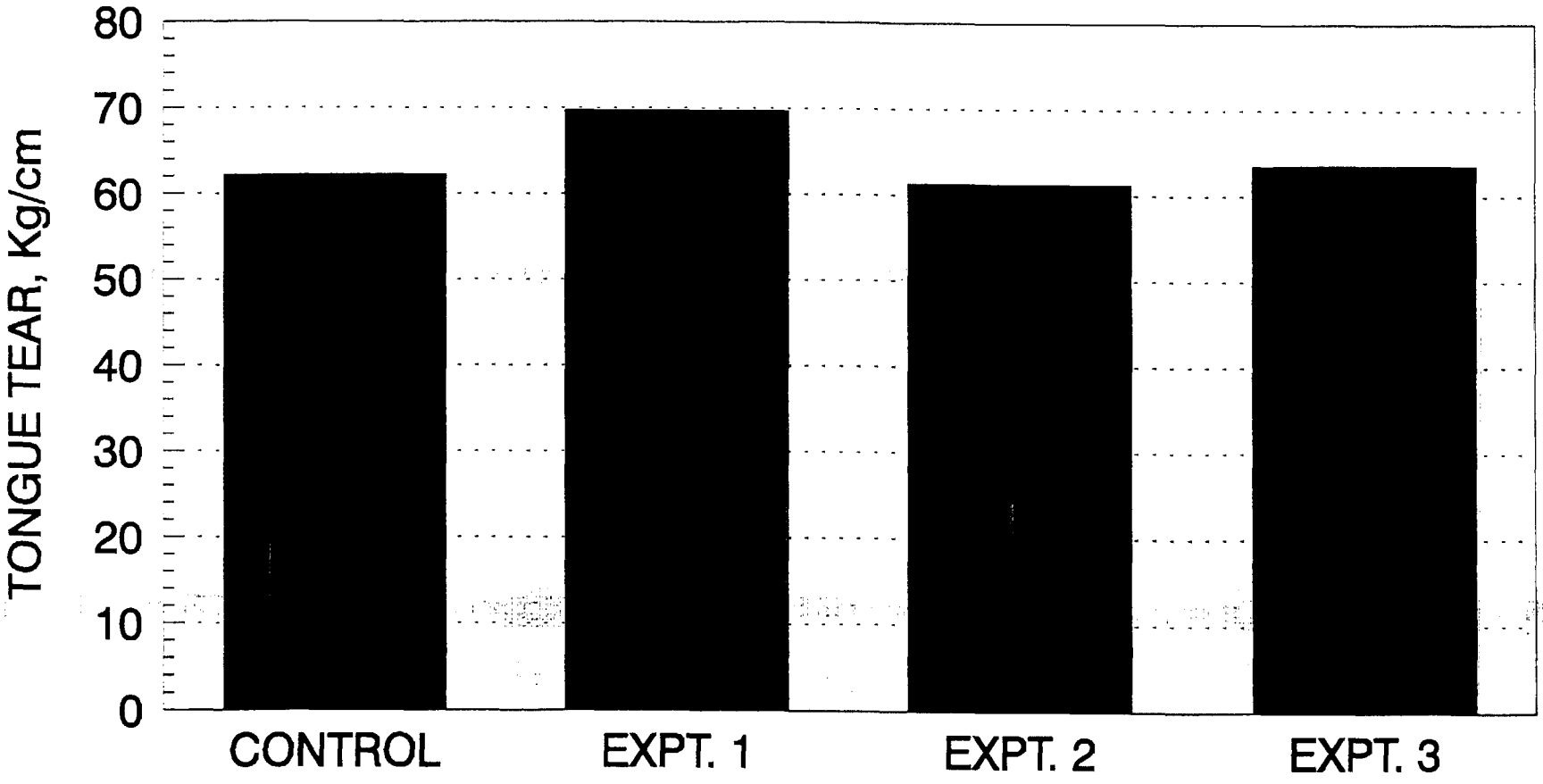
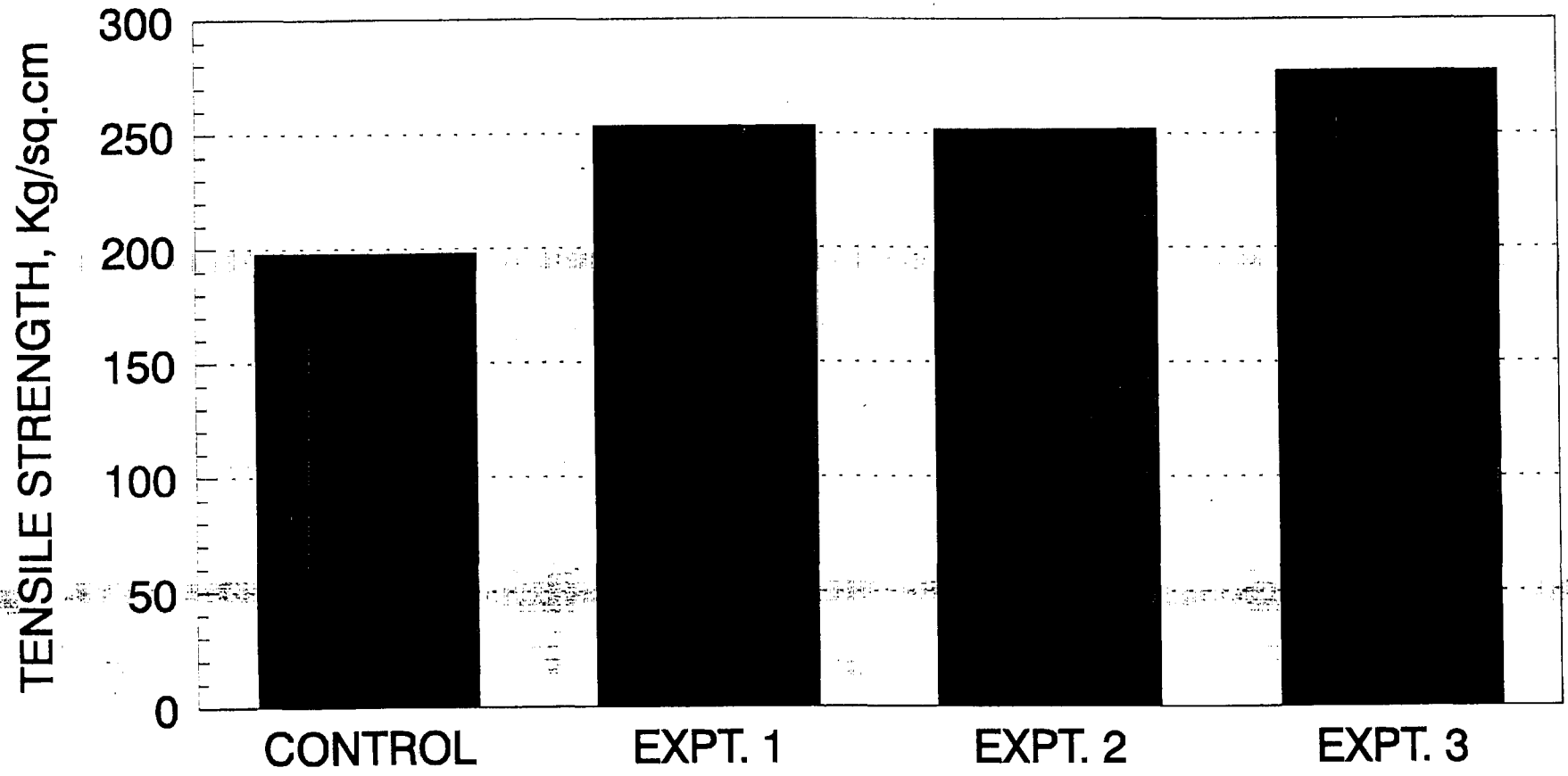


Fig: 7.2 PHYSICAL TEST DATA OF LEATHERS



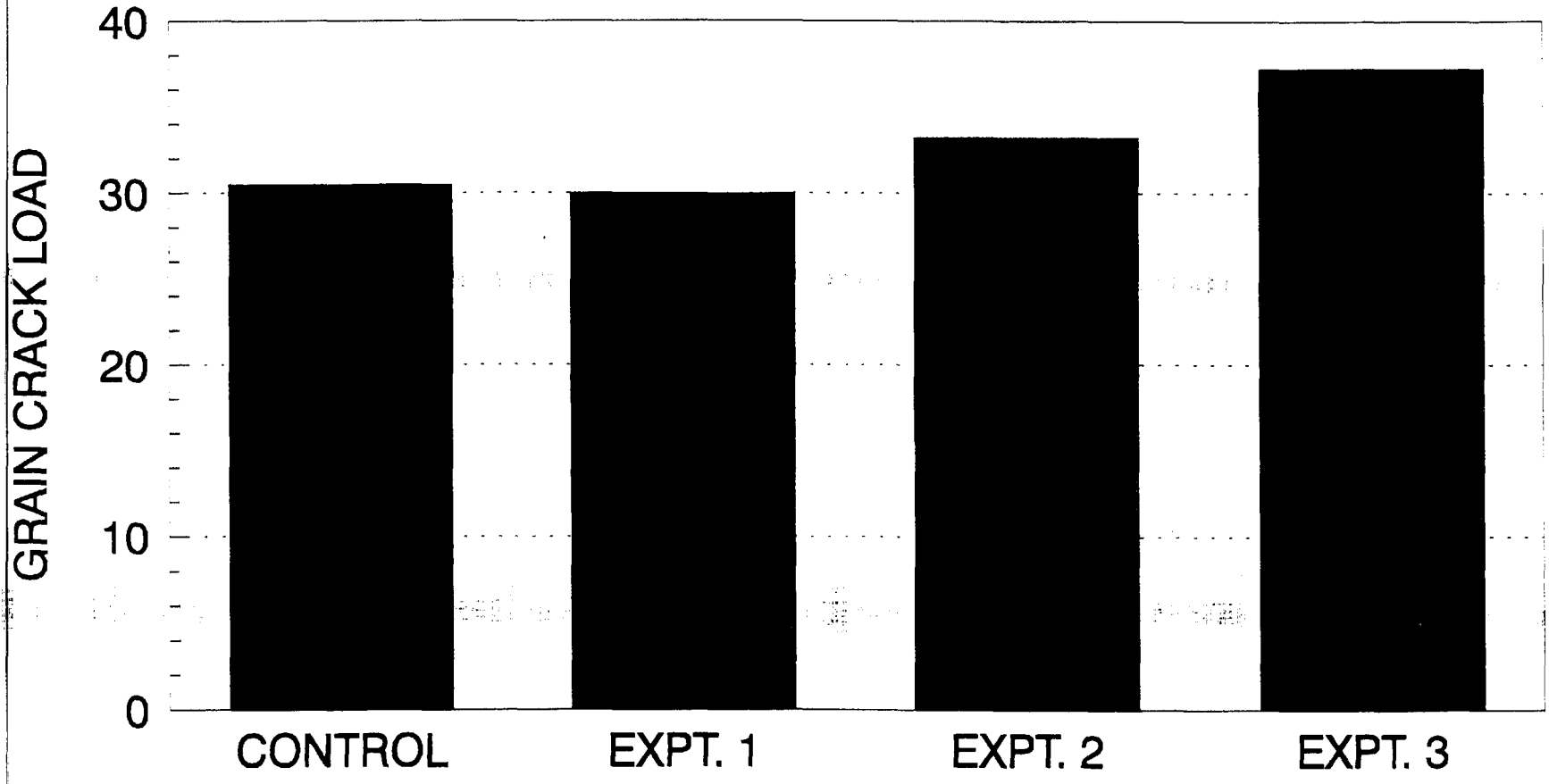
CONTROL : Conventional processing
EXPT 1 : Carbondioxide deliming
EXPT 2 : Carbondioxide deliming + high performance syntan
EXPT 3 : Carbondioxide deliming + high performance syntan + exhaust aid

Fig: 7.3 PHYSICAL TEST DATA OF LEATHERS



CONTROL : Conventional processing
EXPT 1 : Carbondioxide deliming
EXPT 2 : Carbondioxide deliming + high performance syntan
EXPT 3 : Carbondioxide deliming + high performance syntan + exhaust aid

Fig: 7.4 PHYSICAL TEST DATA OF LEATHERS



CONTROL : Conventional processing
EXPT 1 : Carbondioxide deliming
EXPT 2 : Carbondioxide deliming + high performance syntan
EXPT 3 : Carbondioxide deliming + high performance syntan + exhaust aid

8. TECHNO-ECONOMIC VIABILITY OF PROJECT

AMMONIA FREE DELIMING AND CLEANER WET TANNING OPERATIONS

INVESTMENT COST

(All figures in US$)

ITEM	TANNERY	UNIDO	CLRI	TOTAL
CIVIL WORKS	33,300	-	-	33,300
EQUIPMENT	-	52,000	15,500	67,500
TOTAL	33,300	52,000	15,500	1,00,800
PERCENT	33	52	15	100

AMMONIA FREE DELIMING AND CLEANER WET TANNING OPERATIONS

OPERATION AND MAINTENANCE COST/YEAR

ITEM	COST in US$
MATERIAL	1000
EQUIPMENT MAINTENANCE	4300
ELECTRICITY	1400
LABOR	1000
DEPRECIATION	6750
TOTAL	14450

COST BENEFIT ANALYSIS
(INDICATIVE)
AMMONIA FREE CLEANER WET TANNING OPERATIONS

ADDITIONAL COST FOR CLEANER TECHNOLOGY IMPLEMENTATION	Rs 3.6 million
ADDITIONAL ANNUAL OPERATING COST	Rs 0.8 million
BENEFITS-THROUGH VALUE ADDITION	Rs 1.2 million
PAY BACK PERIOD	5 YEARS

COMPARISON OF QUALITY
AMMONIA FREE CLEANER WET TANNING OPERATIONS
(Numerical values indicate percentage of leathers in each grade)

GRADE	CONVENTIONAL PROCESSING	PROCESSING WITH INTEGRATED ECO-FRIENDLY SYSTEM
I	23	31
II	55	57
III	22	12

CARBON-DI-OXIDE DELIMING

ADVANTAGES

- REDUCTION OF NITROGENOUS DISCHARGE IN EFFLUENT
- REDUCTION IN BOD & COD UP TO 50%
- REDUCTION IN AMMONIA ODOR
- IMPROVED GRAIN CHARACTERISTICS
- EASY HANDLING AND AUTOMATION FACILITY

9. RECOMMENDATIONS

9. Recommendations

An attempt is made in this section to highlight the achievements, failures and lessons learnt on implementation of the four technologies under this unique programme supported by UNIDO.

9.1 Achievements

The following conclusions could be drawn from the completed project:

i. Modernization of wet operations in small scale tanneries is not a distant dream but a reality

ii. The personnel of the user tannery, who were never exposed earlier to control instrumentation and chemical handling and transportation equipments, have shown remarkable abilities to operate the new facilities with a high degree of confidence. Their training under simulated conditions at the CLRI pilot tannery and at the actual working environment had helped them immensely.

iii. The techno-economic viability of this technology is greatly influenced by the extent of improvement achieved in the final leather quality and its consistency.

iv. The following could be established during post demonstration phase:

   a) Qualitative improvement in Inplant ecology and work culture of personnel after implementation of the project
   b) Improved documentation of process data
   c) Less direct exposure of operating personnel to chemicals
   d) Minimization of process time and chemical wastages

v. Techno-economic viability of ecofriendly processes can be enhanced by an appropriate grouping of technology packages.

vi. Willingness of tanners to invest in modernization and ecofriendly technological options if they are made to convince about the real terms benefits.

9.2 Drawbacks and Unachievable Targets

9.2.1 Time Over-run

A significant time overrun (about 12 months) had taken place in this project for the following reasons:

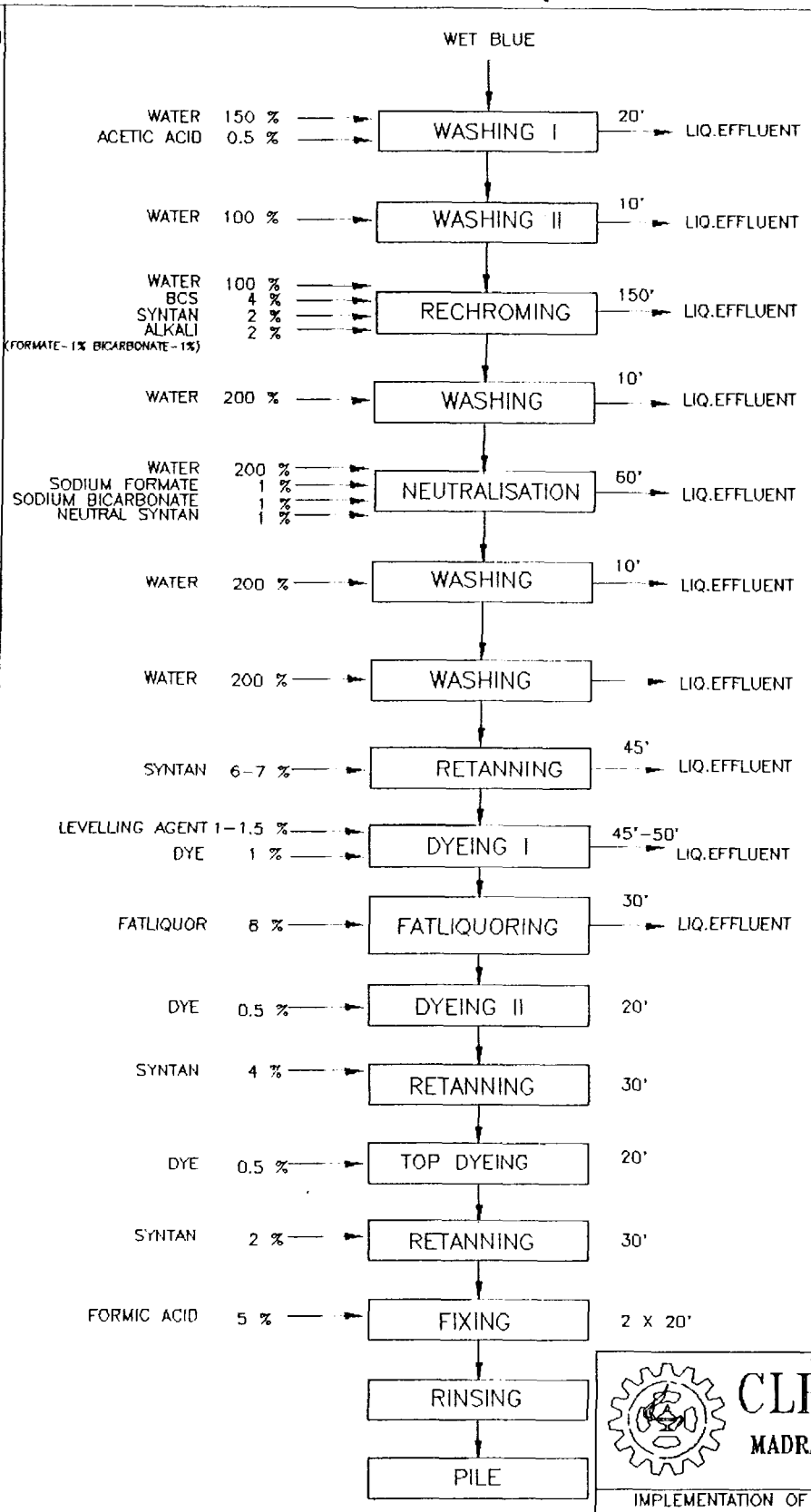
i. Change of user tannery due to unforeseen reasons
ii. Time delay in locating a competent project engineering company to executive the programme.
iii. Delays in equipment deliveries by the manufacturing companies.
iv. Teething troubles during installation and lack of local expertise in quick trouble shooting.
v. Raw material shortages faced by the user industry.

9.2.2 Unachieved Objectives/Targets

i. The total replacement of ammonium salts in deliming of thick hides could not be achieved due to lack of lime splitting facilities at the site.
ii. Frequent changes in the rawstock type and quality has made the benefit evaluation process more cumbersome.
iii. Hot water control system could not be fully implemented due to lack of adequate steam generation capacity at the site.

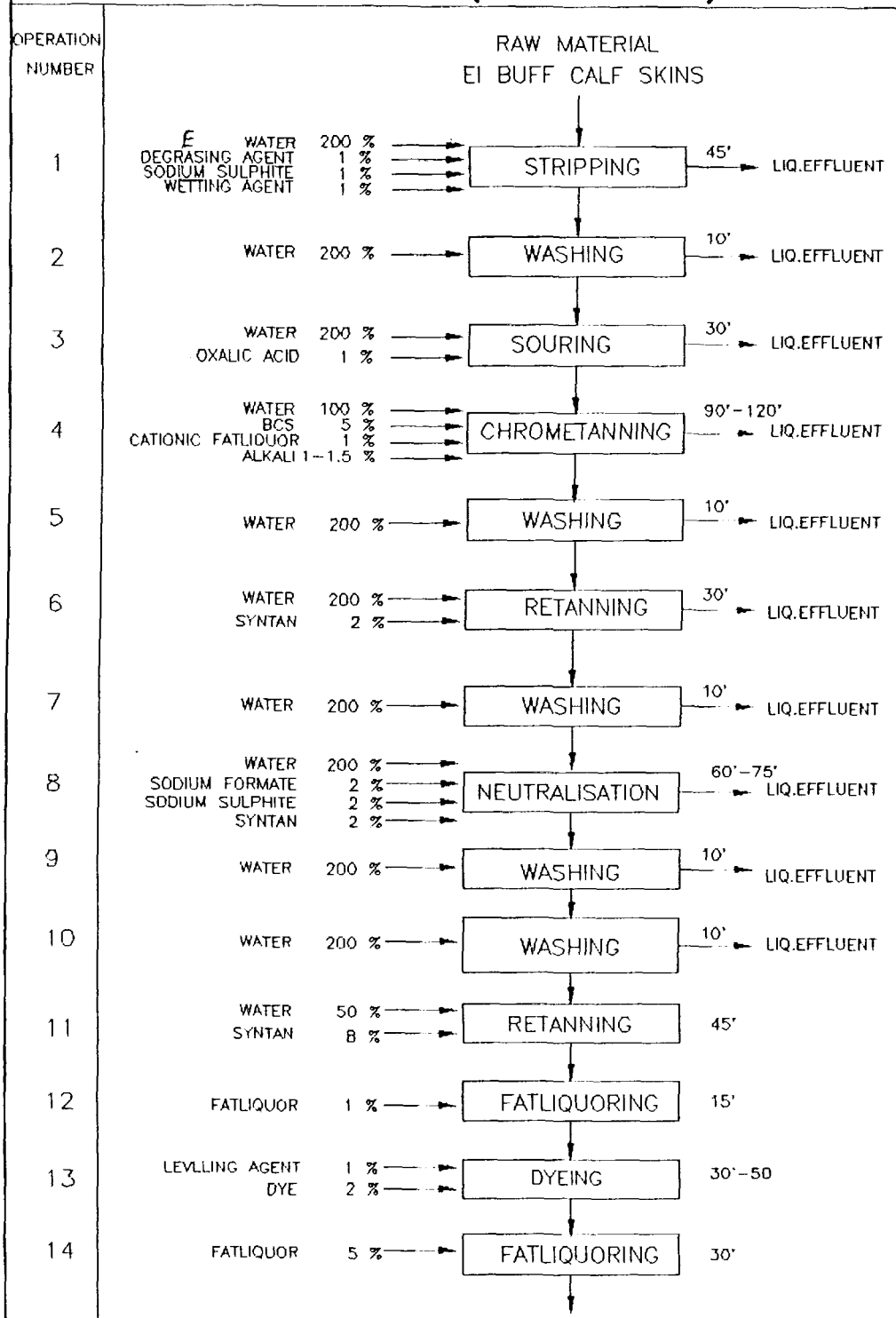
ANNEXURE - I
PROCESS RECEIPE

PROCESS FLOW SHEET FOR RETANNING FATLIQUORING AND DYEING (COW WAXY LEATHER)



UNI1861/JS

PROCESS FLOW SCHEME FOR PREPARING BUFF CALF (BURNISHABLE) LEATHER



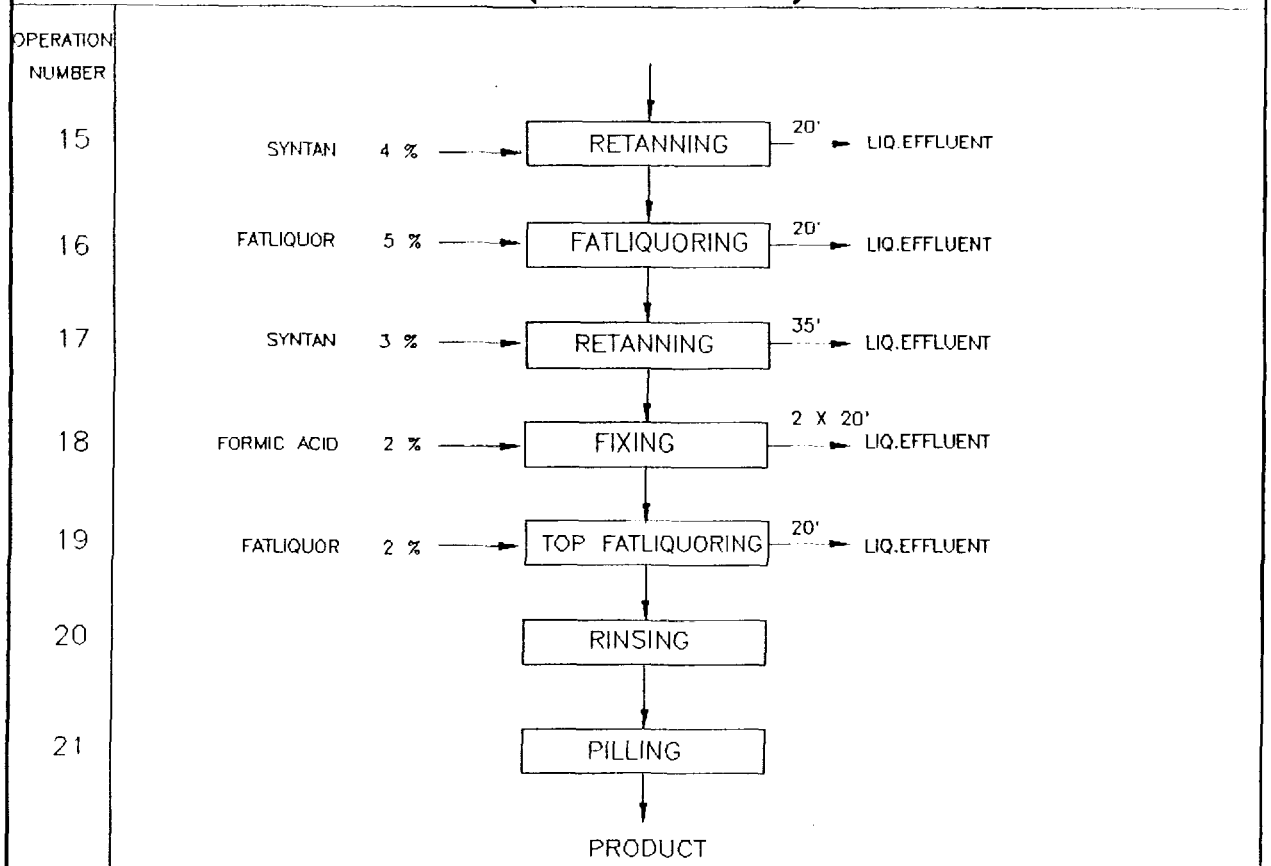
CLRI MADRAS

Sheet	1
Drawn	JS
Scale	NTS

IMPLEMENTATION OF AMMONIA FREE AND ENVIRONMENTALLY CLEANER TECHNOLOGIES
M/S TEJOMAL'S TANNERY, PERNUMBUTT.

UNI1862/JS

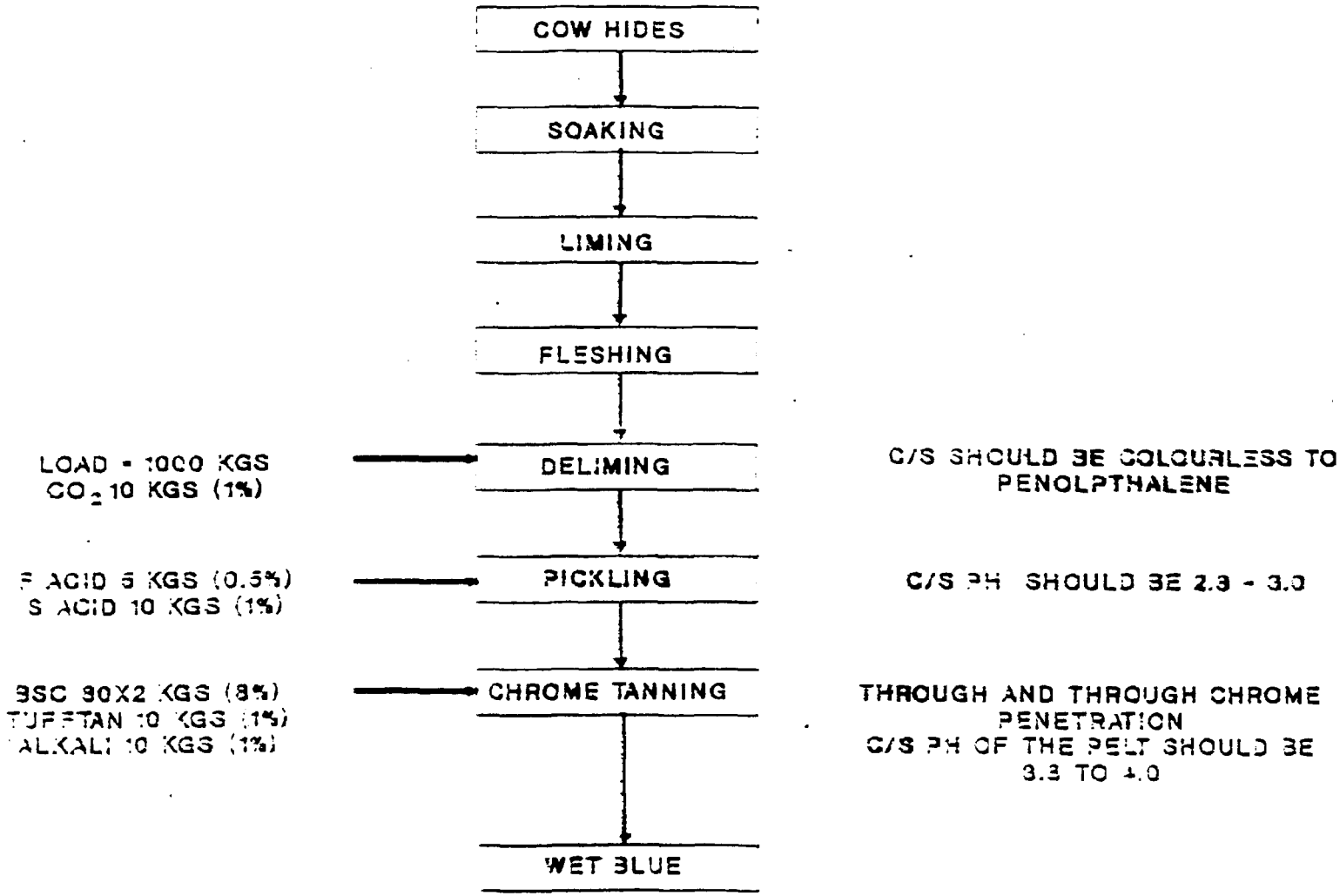
PROCESS FLOW SCHEME FOR PREPARING BUFF CALF (BURNISHABLE) LEATHER



CLRI MADRAS	Sheet	1
	Drawn	JS
	Scale	NTS

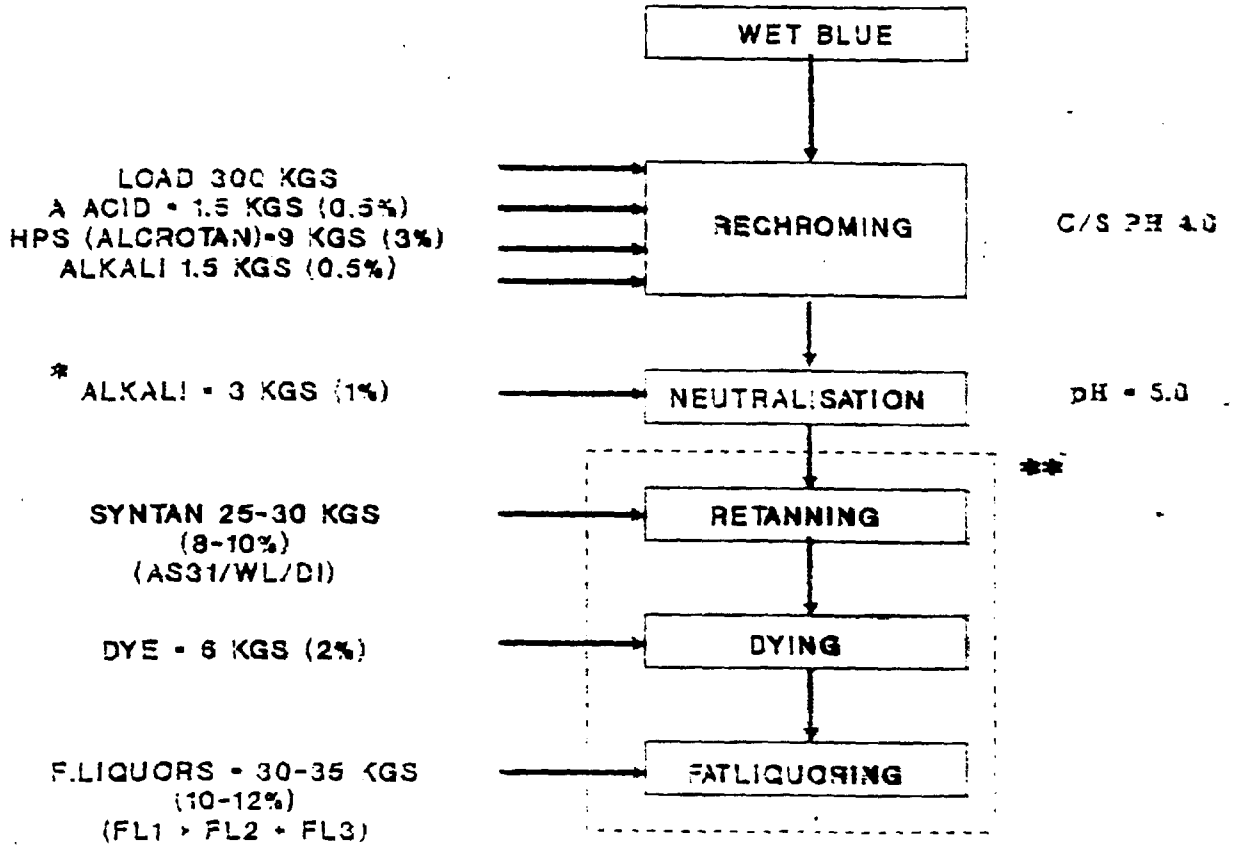
IMPLEMENTATION OF AMMONIA FREE AND ENVIRONMENTALLY CLEANER TECHNOLOGIES
M/S TEJOMAL'S TANNERY, PERNUMBUTT.

UNI1862A/JS



FIGURE

BROAD PROCESS FLOW DIAGRAM FOR WET BLUE MANUFACTURE AT M/S TEJOOMALS

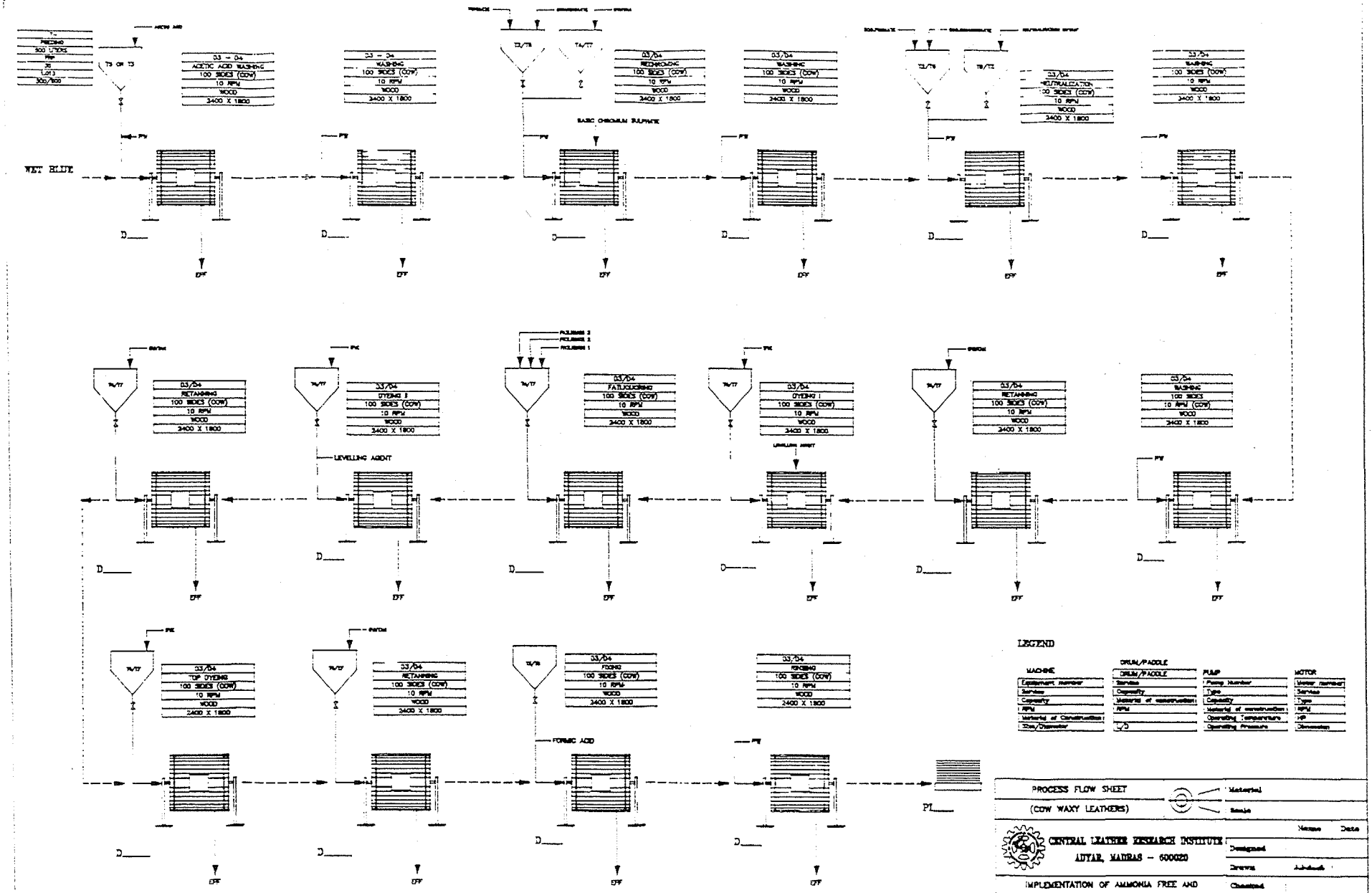


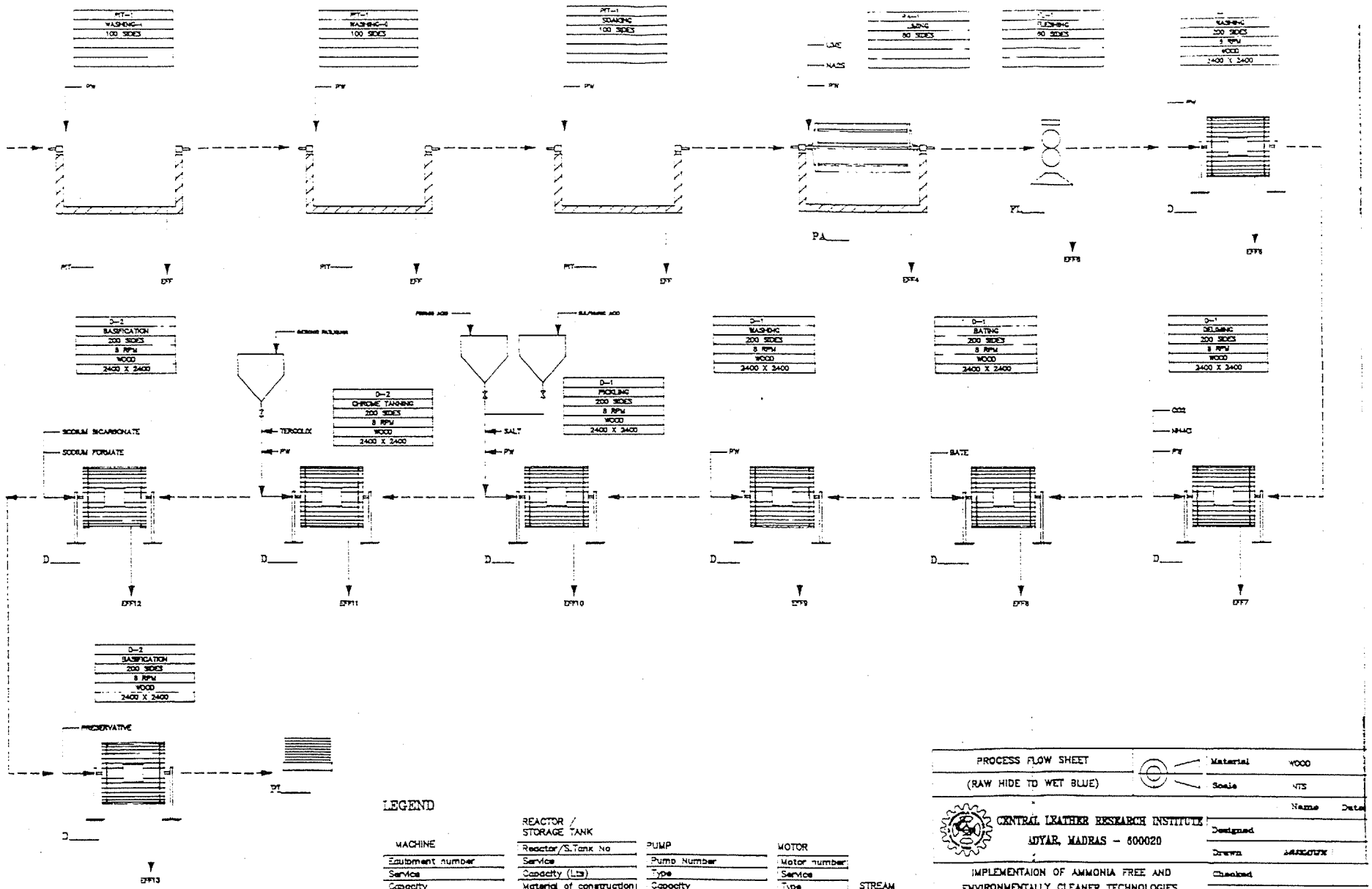
** Chemicals and their quantities varies depending on the type of order for the finished leather

* Alkali used here is mixture of 50% sodium formate and 50% sodium bicarbonate, dissolved in water to make 10% solution

FIG : BROAD PROCESS FLOW DIAGRAM FOR CRUST LEATHER MANUFACTURE AT M/S.TEJOOMALS TANNERY

ANNEXURE - II
PROCESS FLOW SHEETS


WET BLUE
BASIC CHROMIUM SULPHATE
LEVELLING AGENT
FORMIC ACID
EFF
PL
LEGEND
MACHINE
DRUM/PADDLE
PUMP
MOTOR
PROCESS FLOW SHEET
(COW WAXY LEATHERS)
CENTRAL LEATHER RESEARCH INSTITUTE
ADYAR, MADRAS - 600020
IMPLEMENTATION OF AMMONIA FREE AND ENVIRONMENTALLY CLEANER TECHNOLOGIES.
M/S TEJOOMAL'S TANNERY,PERUMBUTT.
(MODIFYING PROCESS)



LEGEND

MACHINE	REACTOR / STORAGE TANK	PUMP	MOTOR	STREAM
Equipment number	Reactor/S.Tank No	Pump Number	Motor number	Stream No
Service	Service	Type	Service	Temperature
Capacity	Capacity (Lts)	Capacity	Type	Pressure
RPM	Material of construction	Material of construction	RPM	
Material of Construction	Operating Temperature	Operating Temperature	HP	
Size/Diameter	Operating Pressure	Operating Pressure	Dimension	

PROCESS FLOW SHEET
(RAW HIDE TO WET BLUE)

CENTRAL LEATHER RESEARCH INSTITUTE
ADYAR, MADRAS - 600020

IMPLEMENTAION OF AMMONIA FREE AND ENVIRONMENTALLY CLEANER TECHNOLOGIES.
M/S TEJOOMAL'S TANNERY,PERNUMBUTT.

Material	WOOD	
Scale	NTS	
	Name	Date
Designed		
Drawn		
Checked		
Drawing no	UN1337	
Sheet	1 OF 1	

ANNEXURE - III.1
EQUIPMENTS SPECIFICATION

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

Page 1 of 22

REQUISTION NUMBER 92/1___

PPCSA |___|___|___|___|

MISPI No. |___|___|___|___|

Date 14 Dec 1992

LOCAL PURCHASE REQUESTED |X|

HEAD QUARTERS PURCHASE |_|

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES	Project Number US/IND/90/244(2)
AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS	Sub Contracts |___| 21 - |___|___|
Z. KOTASEK, CHIEF TECHNICAL ADVISER	Expendable Equipment |___| 41 - 1
	Non-Expendable Equipment |X| 42 - 0 1
	Premises |___| 43 - 0 1
	Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE :
(CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
1	5	Pcs	Centrifugal Pumps (2.4.1 OF ANNEXURE-III)	2500
			Capacity : 25 LPM	
			Head : 2 met of water	
			Suction side : 1" dia	
			Delivery : 1"	
			Material of construction : SS 316/Poly Propylene/FRP	
			Operating Temperature : 100 deg C	
			(List of suppliers are shown in Annexure VI 1-8)	
			TOTAL	2500

SPECIAL INSTRUCTIONS :

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SU3STANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE,

ADYAR, MADRAS 600 020, INDIA

Target Date : MAY93

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

Page 2 of 22

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/2

PPCSA

LOCAL PURCHASE REQUESTED [X]

MISPI No.

HEAD QUARTERS PURCHASE [ ]

Date 14 December 1992

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES	Project Number US/IND/90/244(2)
AMMONIA FREE AND CLEANER WET TANNING OPERATIONS	Sub Contracts [ ] 21 - [ ]
DR.Z.KOTASEK, CHIEF TECHNICAL ADVISOR	Expendable Equipment [ ] 41 - 1
	Non-Expendable Equipment [X] 42 - 0 1
	Premises [ ] 43 - 0 1
	Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE :
(CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
2	5	Pcs	pH Indicator cum Transmitter with temperature compensators	4167
			for incorporating in the float recycle line of tanning drums	
			pH range : 0-14 (2.4.2 OF ANNEXURE-III)	
			Accuracy : ±0.1 pH	
			Should give 4-20 mA Output	
			Output with local digital display	
			Inlet/Outlet Flanges : 1"dia	
			(List of suppliers are shown in Annexure VI , 9-12)	
			TOTAL	4167

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS 600 020, INDIA

Target Date : MAY 93

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/3

PPCSA

LOCAL PURCHASE REQUESTED [X]

HEAD QUARTERS PURCHASE [-]

MISPI No.

Date 14 December 1992

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES

AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS

Z. KOTASEK, CHIEF TECHNICAL ADVISER

Project Number US/IND/90/244(2)

Sub Contracts	[ ]	21 -
Expendable Equipment	[ ]	41 - 1
Non-Expendable Equipment	[X]	42 - 0 1
Premises	[ ]	43 - 0 1

Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE :
(CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
3	2	Pcs	High Pressure Seamless Steel Cylinder of about 50 kg capacity with	667
			capnecking valve; and two stage gas regulator for carbon-di-oxide (As per	
			ISI standards for Carbon-di-oxide storage)	
			(2.5.1 OF ANNEXURE - III)	
			(Please see Annexure VI 13-16 for list of suppliers)	
			TOTAL	667

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/o Central Leather Research Institute

Adyar MADRAS - 600 020, INDIA

Target Date : MAY 93

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/4

PPCSA

LOCAL PURCHASE REQUESTED [X]

MISPI No.

HEAD QUARTERS PURCHASE [ ]

Date 14 December 1992

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES

AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS

Z.KOTASEK, CHIEF TECHNICAL ADVISER

Project Number US/IND/90/244(2)

Sub Contracts	[ ]	21 -
Expendable Equipment	[ ]	41 - 1
Non-Expendable Equipment	[X]	42 - 0 1
Premises	[ ]	43 - 0 1

Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE : (CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
4	4	Pcs	HDPE/FRP Intermediate chemical storage tanks with stirrer removable	700
			(half) open type lid and conical bottom	
			Capacity : 250 lit	
			Nozzles on the top lid 2 (1") plus vent line	
			Nozzles on the bottom 1 (1")	
			Temperature : Operating = 65 deg C; Maximum = 100 deg C	
			Pressure : Operating = 1.2 kg/sq cm; Design = 2 kg/sq cm	
			The storage tanks should be provided with portable agitator with	
			propeller blade all made of SS 316 driven by 0.5 HP geared motor at 375	
			rpm supported on a suitable structure	
			(3.1 & 3.2 of Annexure-I)	700

SPECIAL INSTRUCTIONS :

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS-600 020, INDIA

Target Date : MAY 93

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/5

PPCSA

LOCAL PURCHASE REQUESTED [X]

HEAD QUARTERS PURCHASE [-]

MISPI No.

Date 14 December 1992

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES	Project Number US/IND/90/244(2)
AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS	Sub Contracts [ ] 21 - [ ] [ ]
Z.KOTASEK, CHIEF TECHNICAL ADVISER	Expendable Equipment [ ] 41 - 1
	Non-Expendable Equipment [X] 42 - 0 1
	Premises [ ] 43 - 0 1
	Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE :
(CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
5	3	Pcs	HDPE/FRP Storage tanks	700
			Capacity : 250 lit = 1 No; 150 lit = 2 Nos	
			Nozzles : Top lid : 2 (1"); Bottom lid : 1 (1") plus ventline on top lid	
			Temperature : Operating - 65 deg C	
			Maximum - 100 deg C	
			Pressure : Operating - 1.2 Kg/sq.cm	
			Maximum - 2.0 Kg / sq.cm	
			(Please refer 3.1 & 3.2 of Annexure III)	
			(Please refer Annexure VI 17-22 for list of supplier)	
			TOTAL	700

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS-600 020, INDIA

Target Date : MAY 93

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISITION NUMBER 92/6___

PPCSA |__|__|__|__|

MISPI No. |__|__|__|__|

LOCAL PURCHASE REQUESTED |_X__|

HEAD QUARTERS PURCHASE |_-__|

Date 14 December 1992

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES	Project Number US/IND/90/244(2)
AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS	Sub Contracts |___| 21 - |___|___|
Z.KOTASEK, CHIEF TECHNICAL ADVISER	Expendable Equipment |___| 41 - 1
	Non-Expendable Equipment |_X__| 42 - 0 1
	Premises |___| 43 - 0 1
	Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE : (CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
6	5	Pcs	Bulk chemical storage tanks. Material of construction HDPE/FRP	2000
			i) Maximum capacity : 1000 lit; 1 No	
			Nozzles : Top-3 Nos (65 mm dia; 15 mm plus vent) Bottom-1 No (25 mm dia)	
			ii) Maximum Capacity : 750 Lit; 1 No	
			Nozzles :Top-3 Nos (65 mm dia; 15 mm plus vent) Bottom-1 No (25 mm dia)	
			iii) Maximum capacity : 1500 lit; 1 No	
			Nozzles :Top-3 Nos (65 mm dia; 20 mm plus vent) Bottom-1 No (25 mm dia)	
			iv & v) Maximum Capacity : 20 Lit ; 2 No	
			Nozzles :Top-2 Nos(20 mm dia plus vent) Bottom-1 No (25mm)	
			Tank should be provide with suitable brackets to support on the mazzanine floor	
			(Please refer Annexure III of 3.1 & 3.2).(Please refer Annexure VI	
			17-22 for list of suppliers) Contd...(Page 7)	
			TOTAL	2000

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS-600 020, INDIA

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/7

PPCSA

LOCAL PURCHASE REQUESTED [X]

HEAD QUARTERS PURCHASE [ ]

MISPI No.

Date 14 December 1992

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES	Project Number US/IND/90/244(2)
AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS	Sub Contracts [ ] 21 - [ ] [ ]
Z.KOTASEK, CHIEF TECHNICAL ADVISER	Expendable Equipment [ ] 41 - 1
	Non-Expendable Equipment [X] 42 - 0 1
	Premises [ ] 43 - 0 1
	Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE : (CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
7	1	Pc	Air compressor with 200 lit storage tank, drier and oil filter	833
			with appropriate capacity to provide instrument grade air to the	
			control valves and purging of the chemical lines	
			Air discharge pressure : 10 kg/sq cm	
			Capacity : 5-7 cu.m/hr	
			(Please see Annexure III of item 42 of flash report A)	
			(Please refer Annexure VI; 23-25 for list of suppliers)	
			TOTAL	833

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS 600 020, INDIA

Target Date : MAY 93

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/8___

PPCSA |___|___|___|___|

MISPI No. |___|___|___|___|

Date 14 December 1992

LOCAL PURCHASE REQUESTED |_X_|

HEAD QUARTERS PURCHASE |___|

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES	Project Number US/IND/90/244(2)
AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS	Sub Contracts |___| 21 - |___|___|
Z.KOTASEK, CHIEF TECHNICAL ADVISER	Expendable Equipment |___| 41 - 1
	Non-Expendable Equipment |_X_| 42 - 0 1
	Premises |___| 43 - 0 1
	Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE :
(CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
8	1	Pc	Chemical addition system Pump	1167
			Capacity : 50 lit/min	
			Head : 10 meters of water	
			Material of construction : Impeller and liquid contact parts :	
			Polypropylene/FRP	
			Suction and delivery flanges : 1" dia	
			The pump should also work for liquid with air mixture	
			Operating temperature : 65 deg C	
			Design temperatur : 100 deg C	
			(Please see annexure III item 4.2 of flash report)	
			(Please refer Annexure VI, 1-8 list of suppliers)	
			TOTAL	1167

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS-600 020, INDIA

Target Date : MAY 93

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
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UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/9

PPCSA

MISPI No.

Date 14 December 1992

LOCAL PURCHASE REQUESTED [X]

HEAD QUARTERS PURCHASE [ ]

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES

AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS

Z.KOTASEK, CHIEF TECHNICAL ADVISER

Project Number US/IND/90/244(2)

Sub Contracts	[ ]	21 - [ ] [ ]
Expendable Equipment	[ ]	41 - 1
Non-Expendable Equipment	[X]	42 - 0 1
Premises	[ ]	43 - 0 1

Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE : (CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
9	5	Pcs	Chemical transfer pumps	5000
			Capacity : 5 LPM (1 No), 10 LPM (1 No), 20 LPM (3 Nos)	
			Head : 5 meters of water for all pumps	
			Material of construction (Impeller and liquid contact parts)	
			Polypropylene/FRP	
			Temperature : 100 deg C	
			(Please see annexure III item 4.3 of flash report A)	
			(Please ref Annexure VI, 1-8 for list of suppliers)	
			TOTAL	5000

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS 600 020, INDIA

Target Date : MAY 93

Original : CON/GSD/DA
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Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
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UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/10

PPCSA

MISPI No.

Date 14 December 1992

LOCAL PURCHASE REQUESTED [X]

HEAD QUARTERS PURCHASE [-]

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES

AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS

Z.KOTASEK, CHIEF TECHNICAL ADVISER

Project Number US/IND/90/244(2)

Sub Contracts		21 -
Expendable Equipment		41 - 1
Non-Expendable Equipment	X	42 - 0 1
Premises		43 - 0 1

Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE : (CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
10	1	Pc	Design, fabrication, supply of water heater with steam injection	2000
			of water flow rate at exit : 500-600 LPH	
			Water inlet/outlet Temperature : 30/65 deg C	
			Water/Steam Pressure : 2.5 to 3 kg/sq cm	
			Inlet/Outlet flanges : 65 mm	
			(Please refer Annexure III item 6.2.1 of flash report A)	
			(Please refer Annexure VI, 26-29 for list of suppliers)	
			TOTAL	2000

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS 600 020, INDIA

Target Date : MAY 93

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
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Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

Page _11_ of __22__

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/11

PPCSA |__|__|__|__|

LOCAL PURCHASE REQUESTED |_X__|

MISPI No. |__|__|__|__|

HEAD QUARTERS PURCHASE |_-__|

Date 14 December 1992

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES	Project Number US/IND/90/244(2)
AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS	Sub Contracts |___| 21 - |___|___|
Z.KOTASEK,CHIEF TECHNICAL ADVISER	Expendable Equipment |___| 41 - 1
	Non-Expendable Equipment |_X_| 42 - 0 1
	Premises |___| 43 - 0 1
	Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE :
(CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
11	1	Pc	Centrifugal pump for cold water supply to water heater system	650
			Capacity : 500-600 LPM	
			Head : 5 meters	
			Suctional delivery flanges : 65 mm	
			Material of construction : SS 304	
			Delivery water pressure : 2.5 to 3 kg/cm^2	
			(This is a part of Item 6.2.1 of Annexure III, item 6.2 of flash reportA)	
			(Please refer Annexure VI, 1-8 for list of suppliers)	
			TOTAL	650

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS - 600 020, INDIA

Target Date : MAY 93

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

ANNEXURE - III.2
INSTRUMENTS SPECIFICATION

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/12

PPCSA

MISPI No.

Date 14 December 1992

LOCAL PURCHASE REQUESTED [X]

HEAD QUARTERS PURCHASE [ ]

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES

AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS

Z.KOTASEK, CHIEF TECHNICAL ADVISER

Project Number US/IND/90/244(2)

Sub Contracts	[ ]	21 - [ ] [ ]
Expendable Equipment	[ ]	41 - 1
Non-Expendable Equipment	[X]	42 - 0 1
Premises	[ ]	43 - 0 1

Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE :
(CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
12	1	Pc	2/2 way control valve with pneumatic diaphragm actuator for steam control, with I/P convertor, 4-20 mA/3-15 PSI. Linear variation with position indicating limit switch Size : 1"; Body : Cast Iron; Application : Steam control Stem Packing : Graphitised teflon to withstand upto 300 deg C with facility for manual operation (Please refer Annexure III item 6.2.2 of flash report A) (Please refere Annexure VI 30-34 for list of suppliers)	833
			TOTAL	833

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR MADRAS-600 020 INDIA

Target Date :

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

Page __13__ of __22____

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/13__

PPCSA |__|__|__|__|

LOCAL PURCHASE REQUESTED |_X__|

MISPI No. |__|__|__|__|

HEAD QUARTERS PURCHASE |_-__|

Date 14 December 1992

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS Z.KOTASEK, CHIEF TECHNICAL ADVISER	Project Number US/IND/90/244(2) Sub Contracts |___| 21 - |___|___| Expendable Equipment |___| 41 - 1 Non-Expendable Equipment |_X__| 42 - 0 1 Premises |___| 43 - 0 1 Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE :
(CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
13	1	Pc	Flow Indicator Controller for water and gas service comprises of	
			a) Flow transmitter : Range = 100-1000 LPM for water Mounting flange 65mm	1333
			Range = 1-10 LPM for gas Mounting Flange 25mm	
			Temperature : 100 deg C; Output : 4-20 mA	
			b) Flow indicator/controller local/remore/digital	
			c) Flow integrator with high/low set points for the above	
			(Please refer Annexure III Item 6.2.3 of flash report A)	
			Please refer Annexure III 30-34 for list of suppliers	
			TOTAL	1333

SPECIAL INSTRUCTIONS :

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/o Central Leather Research Institute,

Adyar MADRAS 600 020 INDIA

Target Date : May 93

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/14

PPCSA

MISPI No.

Date 14 December 1992

LOCAL PURCHASE REQUESTED [X]

HEAD QUARTERS PURCHASE [-]

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES

AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS

Z.KOTASEK, CHIEF TECHNICAL ADVISER

Project Number US/IND/90/244(2)

Sub Contracts		21 -
Expendable Equipment		41 - 1
Non-Expendable Equipment	X	42 - 0 1
Premises		43 - 0 1

Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE :
(CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
14	30	Pcs	2/2 way pnumatic rotary actuated ball valves for chemical service or	8333
			or solenoid valves	
			Stem seal : Teflon; Flange : 15 mm = 3 Nos; 20 mm = 3 Nos;	
			25 mm = 23 Nos; 40 mm = 1 No	
			A solenoid actuation with 230 V/AC/Pnumatic air 6 bar differential line	
			pressure to withstand upto 10 bar (working pressure)	
			Material of construction : SS 316 indicating limit switch for ON/OFF	
			(Please refer Annexure III, item 7.1 of flash report A)	
			(Please see Annexure VI, 35-45 for list of suppliers)	
			TOTAL	8333

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS-600 020, INDIA

Target Date : MAY 93

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

Page 15 of 22

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/15

LOCAL PURCHASE REQUESTED [X]

HEAD QUARTERS PURCHASE [ ]

PPCSA [ ][ ][ ][ ]

MISPI No. [ ][ ][ ][ ]

Date 14 December 1992

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES	Project Number US/IND/90/244(2)
AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS	Sub Contracts [ ] 21 - [ ][ ]
Z.KOTASEK, CHIEF TECHNICAL ADVISER	Expendable Equipment [ ] 41 - 1
	Non-Expendable Equipment [X] 42 - 0 1
	Premises [ ] 43 - 0 1
	Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE :
(CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
15	12	Pcs	2/2 way pnumatic cylinder operated (plunger type) control valves for	6667
			water service or solenoid valves	
			Stem Seal : Teflon; with solenoid actuator; 230 V/AC/Pnumatic air	
			6 bar. Working pressure : 10 bar; Material of construction : SS 316	
			Indication for limit switch for ON/OFF; Port size/flange : 65 mm	
			(Please refer Annexure III item 7.2 of flash report A)	
			(Please see Annexure VI 35-45 for list of suppliers)	
			TOTAL	6667

SPECIAL INSTRUCTIONS :

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

for :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS - 600 020, INDIA

Target Date : MAY 93

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

Page 16 of 22

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISITION NUMBER 92/16

PPCSA

LOCAL PURCHASE REQUESTED |X|

MISPI No.

HEAD QUARTERS PURCHASE |-|

Date 14 December 1992

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES	Project Number US/IND/90/244(2)
AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS	Sub Contracts | | 21 - | |
	Expendable Equipment | | 41 - 1
Z.KOTASEK,CHIEF TECHNICAL ADVISER	Non-Expendable Equipment |X| 42 - 0 1
	Premises | | 43 - 0 1
	Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE : (CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
16	1	Pc	Temperature transmitter (RTD type) to measure the outlet	200
			temperature of steam injection water system	
			Range : 0-150 deg C; Accuracy : ±1 deg C with a provision to	
			get an output of 4-20 mA	
			(Please refer Annexure III, item 6.2.1 Temperature transmitter is part of	
			steam injection water heater)	
			Please refer Annexure VI 35-45 for list of suppliers	
			TOTAL	200

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS-600 020, INDIA

Target Date : MAY 93

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

Page _17__ of __22__

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISITION NUMBER 92/17__

LOCAL PURCHASE REQUESTED |_X__|

HEAD QUARTERS PURCHASE |_-__|

PPCSA |__|__|__|__|

MISPI No. |__|__|__|__|

Date 14 December 1992

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS Z.KOTASEK, CHIEF TECHNICAL ADVISER	Project Number US/IND/90/244(2) Sub Contracts |___| 21 - |___|___| Expendable Equipment |___| 41 - 1 Non-Expendable Equipment |_X__| 42 - 0 1 Premises |___| 43 - 0 1 Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE :
(CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
17	1	Pc	Steam pressure reducing valve	200
			Inlet Pressure : 6 - 8 Kg Sq Cm	
			Outlet Pressure : 2-3 kg/sq cm	
			Inlet/Outlet flange size : 1 "	
			(Please Refer Part of Item 6.2.1 of Annexure III of flash report A)	
			(Please refere Annexure VI 30-34 for list of suppliers)	
			TOTAL	200

SPECIAL INSTRUCTIONS :

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS 600 020, INDIA

Target Date : MAY 93

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER : 92/18

PPCSA |__|__|__|__|

MISPI No. |__|__|__|__|

Date 14 Dec 1992

LOCAL PURCHASE REQUESTED |_X__|

HEAD QUARTERS PURCHASE |____|

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES	Project Number - US/IND/90/244(2)
AMMONIA FREE AND CLEANER WET OPERATIONS	Sub Contracts |____| 21 - |____|____|
	Expendable Equipment |____| 41 - 1
Z.KOTASEK, CHIEF TECHNICAL ADVISER	Non-Expendable Equipment |_X__| 42 - 0 1
	Premises |____| 43 - 0 1
	Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE : (CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
18	1	Pcs	CONTROL MODULES : They shall consist of hardware & Software	25000
			1 Water addition and Temperature control	
			* Controlled water addition into drums and Mixing tank	
			* Controlled hot water addition into drums and mixing tank	
			* Temperature range of control is 35 Deg C to 70 Deg C	
			* Number of drums that can be hooked to the modules are eight	
			2 Drums pH control module	
			* Continuos and controlled addition of chemicals into the drum	
			* Automatically stops adding chemicals into the drum after reaching the pH.	
			* On-Line pH profile display on a CRT screen (Cont... Page 19)	
			TOTAL	25000

SPECIAL INSTRUCTIONS :

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
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Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS-600 020, INDIA

Target Date : MAY 93

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/18

PPCSA

MISPI No.

Date 14 Dec 1992

LOCAL PURCHASE REQUESTED [X]

HEAD QUARTERS PURCHASE [ ]

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES

AMMONIA FREE AND CLEANER WET OPERATIONS

Project Number - US/IND/90/244(2)

Sub Contracts	[ ]	21 - [ ] [ ]
Expendable Equipment	[ ]	41 - 1
Non-Expendable Equipment	[X]	42 - 0 1
Premises	[ ]	43 - 0 1

Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE : (CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
18			3 Chemical ingredients mixing module	
Cont..			* Number of chemical ingradients can be used is eight.	
			* Accurate dosing of chemicals is acheived through load cell weighing system	
			* Homogenous mixing of chemicals through stirrers	
			* Programmable stirring time	
			* Prepared solutions can be routed to any predefined storage tank	
			* Automatic washing of the mixing tank and air purging facility	
			4 Drum duration & Speed control	
			* Drumming duration is programmable from as low as 1 min to 500 min.	
			* Drum speeds (RPM) are programmable	
			* All drums can be independently set and asyncronously operatable	
			(Cont...Page 20) TOTAL	

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS 600 020, INDIA

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/20

PPCSA |__|__|__|__|

MISPI No. |__|__|__|__|

Date 14 Dec 92

LOCAL PURCHASE REQUESTED |_X_|

HEAD QUARTERS PURCHASE |___|

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES	Project Number - US/IND/90/244(2)
AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS	Sub Contracts |___| 21 - |___|___|
Z.KOTASEK, CHIEF TECHNICAL ADVISER	Expendable Equipment |___| 41 - 1
	Non-Expendable Equipment |_X_| 42 - 0 1
	Premises |___| 43 - 0 1
	Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE :
(CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
18			System Capabilities	
Cont...			* Each drum can be independently and effectively controlled	
			* Each drum can be initiated with any taning operation	
			* Any initiated drum can be deinitiated at any stage of the operation	
			* All operations are extendable	
			* Operation repeat facility available	
			* Alarm and audio/visual indications for the convienience of the operator	
			* Overall drum status can be viewed on a mimic panel as well as as on a CRT	
			screen	
			* Mixing tanks, storage tanks and drums can be independently washed	
			* Hardcopies of the process details can be obtained (Cont Page 21)	
			TOTAL	

SPECIAL INSTRUCTIONS :

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS 600 020, INDIA

Target Date : MAY 93

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER 92/21

PPCSA |__|__|__|__|

MISPI No. |__|__|__|__|

Date 14 Dec 92

LOCAL PURCHASE REQUESTED |_X__|

HEAD QUARTERS PURCHASE |____|

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES	Project Number - US/IND/90/244(2)
AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS	Sub Contracts |____| 21 - |____|____|
Z.KOTASEK, CHIEF TECHNICAL ADVISER	Expendable Equipment |____| 41 - 1
	Non-Expendable Equipment |_X__| 42 - 0 1
	Premises |____| 43 - 0 1
	Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE :
(CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
18			II Type of Control :	
Cont...			It is a Microprocessor based system having all the above mentioned	
			modules. Each module can be programmed independently and all drums can	
			independtly call the service of any module.	
			III Process control parameters involved and their ranges	
			a. Water adition & Temp control	
			Water (Volumetric flow) - Programmable depending on the requirement	
			Temperature control range - 35 Deg C to 70 Deg c	
			Number of points - Six (expandable to eight)	
			b. Drum pH control	
			Type - pH probe and transmitter	
			Range - 0-14	
			Number of points - One per drum (Contd. 92/22)	TOTAL

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE

ADYAR, MADRAS 600 020, INDIA

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

Page __22__ of __22__

REQUESTION FOR EQUIPMENT/SUPPLIES/PUBLICATIONS
FOR CONTRACTUAL SERVICE

REQUISTION NUMBER : 92/23

PPCSA |__|__|__|__|

LOCAL PURCHASE REQUESTED |_X_|

MISPI No. |__|__|__|__|

HEAD QUARTERS PURCHASE |___|

Date 14 Dec 1992

IMPLEMENTATION OF ENVIRONMENTALLY CLEANER TECHNOLOGIES AMMONIA FREE AND CLEANER WET TANNERY OPERATIONS Z.KOTASEK,CHIEF TECHNICAL ADVISER	Project Number US/IND/90/244(2) Sub Contracts |___| 21 - |___|___| Expendable Equipment |___| 41 - 1 Non-Expendable Equipment |_X_| 42 - 0 1 Premises |___| 43 - 0 1 Check appropriate box

CLEARED (SUBST. OFFICE) :

Name Section Date

FUNDS AVAILABLE :
(CON/CONTROL)

Name Section Date

CON/GSD/DA :

Received Returned

Item	Quantity	Unit	Description, Specifications, catalogue Number, Reference to Project document component	Est. Cost in US Dollars
18			c. Chemical ingradients mixing	
Cont..			Type - Load cell based	
			Automatic dosable bulk chemicals - Upto eight	
			Manually dosable - any number	
			Mixing tank maximum chargable volumes - 500 Litres	
			(Please refer 8 of Annexure III)	
			(Please refer Annexure VI, 46 for list of suppliers)	
			TOTAL	

SPECIAL INSTRUCTIONS :

Ship Via Surface/Air to : Resident Representative of United Nations Development programme

For :

C/O CENTRAL LEATHER RESEARCH INSTITUTE,

ADYAR, MADRAS 600 020, INDIA

Target Date : MAY 93

Original : CON/GSD/DA
Copy 1 : CHIEF TECHNICAL ADVISER
Copy 2 : CON/CONTROL UNIT
Copy 3 : SUBSTANTIVE BRANCH/SECTION
Copy 4 : DRAFTER

ANNEXURE - III.3
ELECTRICAL WIRING DETAILS

SI.NO	SUB ITEMS AND ITEMS OF WORKS	QUANTITY	RATE	UNIT	AMOUNT
	c) 3 NOS,32 A,415 V,DP Switch fuse switch fuse unit,rewirable type.				
	d) 2 Nos, 15 A/way, 8 Way/Phase, 3 Phase, 415 v, Rewirable type poweer distribution board in sheet steel enclosure original company made erected below the 32 A,TP&N,SFU including inter connection using PVC insulated copper conductors.Make: Standard/Bosma/ Havells.				
	e) 1 No, 0-500 V, AC Voltmeter and 1 No, Selector switch for reading 3 Phase voltages in suitable size MS Sheet steel enclosure made upof 16 SWG sheet steel.				
	f) 1 No, standard size Bus Bar chamber of adequate length,made upof 16SWG sheet steel and MS angle frame work to accomudate the above switches and consisting of 1"x1/8" bare copper busbars duly insulated and supported over insulators etc.,				
	g) Necessary interconnection between bus bars and switches using 7/16 SWG pvc insuleted copper wire using crimping sockets etc., as required.				
	h) Earth bus bar made upof 1"x1/8" bare copper bar at the bottom of the structure and interconnection of earth bus to various switches in the panel using 14 SWG bare copper wire.				
	i) Necessary identification markings on switches and panel using paint including Danger Board stickers as required.	1 Set		set	
6	Supply and fixing of Motor Control Panel over suitable size MS anglr iron frame work and consist of:				
	a) 1 No, 10 A, TPMCB, 415V, enclosed in original company made box and 1 No,DOL starter, L&T/CH make 3 phase, 0.5 HP with over load relay range of 1-1.6A & 230V Novolt coil with necessary interconnection as required (for Strriors).	4 Sets		set	

CENTRAL LEATHER RESEARCH INSTITUTE
Adyar, Madras 600 020

NAME OF THE WORK: PROVIDING ELECTRICIFICATION TO COMPUTER CONTROLLED TANNERY WET PROCESSING MACHINES AT TEJODHAYLS TANNERY, PERAMBUT

Sl.NO	SUB ITEMS AND ITEMS OF WORKS	QUANTITY	RATE	UNIT	AMOUNT
1 (a)	Supply of 3 1/2 core X 50 Sqmm 1.1 KV grade PVC insulated and sheethed armoured aluminium conductor cable confirming to ISI. Make : Tropodure/Universal/Incab/ Gloster	50 Mts	Rs/	mtr.	Rs. Ps.
(b)	Laying of above cable concealed on floor/ over surface on wall etc. as required	50 Mts		mtr.	
2 (a)	Supply of 4 core X 2.5 Sqmm 1.1 KV grade PVC insulated armoured copper conductor cable confirming to ISI, Make: Tropodure/ Universal/Incab/Gloster	175 Mts		mtr.	
(b)	Laying of the above cable on wall/ structure/concealed on floor using clamps etc. as required	175 Mts		mtr.	
3 (a)	Supply of 1.5 Sqmm X 12 core PVC insulated copper conductor control cable	20 Mts		mtr.	
(b)	Fixing of the above cable on wall/in PVC pipe etc. as required	20 Mts		mtr.	
4	Termination of the following size cable using brass cable gland and crimping sockets including connections				
	(a) 3 1/2 core X 50 Sqmm Aluminium cable	2 Nos		each	
	(b) 4 core X 2.5 Sqmm Copper cable	32 Nos		each	
5	Supply and erection of wall mounting type sub-switch board made upof 1"X1"x1/4" MS angle iron frame work of suitable size duly painted and consisting of the following:				
	a) 1 No. 63 A,415 v, TP&N,SFU,Make:EE with HRC fuses with MS cable end box made upof 16 SWG sheet steel.				
	b) 4 Nos, 32 A, 415 v, TP&N,SFU,Rewirable type standard make with MS cable end box made upof 16 SWG sheet steel.				

SI.NO	SUB ITEMS AND ITEMS OF WORKS	QUANTITY	RATE	UNIT	AMOUNT
	b) ------do-------, but for 3 phase 1.5 HP with O/L relay range of 2.5 to 4 A, 230 V No volt coil, L&T/CH make (for chemical pumps)	7 Sets		set	
	c) -------do--------, but for 3 phase, 5 HP with O/L Relay range of 6 to 10 A with 415 v No volt coil, L&T/CH make (for water pump)	2 sets		set	
	d) ---------do--------, but for Air-conditioner 2 KW, with O/L relay range of 10 to 16 A, 32 A contactor with 230 V No volt coil. L&T/CH make.	1 Set		set	
7	Supply and wiring on wall /False celing for Light point using 2 x 1/18 SWG PVC insulated copper wire in PVC Case & Capping including supplying and fixing 1 No. 5 A, 230 V Anchor make Flush type switch over suitable size MS box with 3.2 mm thick white finish hylam sheet, celing rose, interconnection etc., as required.	2 pts		pt	
8	---------do--------, but for fan point including provision for fixing electronic regulator etc., as required.	1 pt		pt	
9	Supply & Fixing 1 No 5 A,230 v, Flush type switch and 1 No 5A Flush type socket, 2-in-1 type in the L&F control Board.	2 Nos		each	
10	Wiring for circuits/computer sockets using 3/20 SWG PVC insulated copper wire in PVC Case & Capping on wall using clamps etc., as required.	20 Mts		mtr	
11	-------do--------, but with 7/20 SWG PVC insulated copper wire in PVC Case &Capping on wall using clamps etc., including connection as required.	10 Mts		mtr	
12	Supply and fixing of Fluroscent light fitting Philips make TBS 50/140 or equivalent mirror optic reflector type, 1x40 W, 230 v,including lamp flush with False celing using necessary support etc., as required.	2 Nos		each	

SI.NO	SUB ITEMS AND ITEMS OF WORKS	QUANTITY	RATE	UNIT	AMOUNT
13	Supply and Fixing of Celing Fan 1200 mm sweep, 230 v, with accessories and electronic regulator from roof truse using suitable length MS down rod with 'O' Ringal one end to fix the Fan (Approximately 6') including connections etc., as required.	1 NO		each	
14	Supply and fixing of lighting DB original company made on suitable size MS angle iron frame work on wall and consisting of the following : a) 1 No. 16 A, DP MCB - incomer b) 4 Nos. 5 A, SPMCB - for circuits/ computer c) Interconnection, neutral link, bus bars etc.	1 Set		set	
15	Supply and fixing of computer power sockets consists of 1 No. 15 A flush type, 5-in-1 socket and 1 No. 15 A flush type switch Anchor make over suitable size MS Box with 5 mm thick white finish hylam sheet top cover, 230 V, Neon Indicator, internal connections etc. as required.	6 Sets		set	
16	Providing of earth with 2" GI pipe B Class 8 Foot length earth electrode. The work involves excavation of earth 2' X 2' X 7' deep, filling the space with alternate layers of charcoal and salt up to a height of 7 foot from ground level around the GI pipe. Connecting 2 Nos. of 8 SWG GI Wire using GI bolts and nuts on the top of the GI pipes to SSB earth bus. Finally providing a masanory work of size 2' X 2' X 1 1/2' height with 1' below the ground level and 1/2' above the ground level, 2" thick RCC slab cover etc. including marking as required.	2 Nos.		each	
17	Supply and running of 2 X 14 SWG bare copper earth wire from SSB earth bus to various motors, circuits along the cable/ wires including providing intermediate bare copper flat earth bus as required.	200 mts		mtr.	

SI.NO	SUB ITEMS AND ITEMS OF WORKS	QUANTITY	RATE	UNIT	AMOUNT
18	Preparation of necessary electrical line diagram, physical lay out, getting approval from the local Electrical-Inspectorate for the system before energisation etc. as required.	Lumpsum		Ls.	
			TOTAL		

ANNEXURE - III.4
CONTROL ROOM DETAILS

Name of the work: Providing Aluminium Partition Cabin Falseceilig, Vinyl Flooring for control room.

Item No.	Description of work	Quantity	Rate	Unit	Amount
1.	Construction of Aluminium Partition of size 10'-0"X10'-0" X 9'-0" height. This cabin should be constructed on the 6" height brick work construction as its base, alround. This cabin stands on its own strength and support. All the supports are to be provided with using heavy duty 2 1/2"X1 1/2"X16 SWG aluminium Rectangular tubes and also grouted on the 6" brick construction as its base. Partition pannels are to be suitably divided as per the direction of the user. The height of the partition is 9'-0". It is divided into 3 equal bays. Bottom bay is to be provided with 12mm thick PLT Novopan board of Interior grade and 2 bays are provided with 4mm thick plain glass. The colour shade of the Novopan will be decided by the user.	400 Sq.ft	158.00	Sq.ft	63200
	On one side of the portion is to be provided with 3'-o"X7'-0" door with suitable aluminium section of 12 SWG in consultation with the user. In the middle of the door, aluminium door handle section is to be provided and concealed door Closer - 1No. is to be provided at the floor or in the top. The door edge should be lipped with felt.				
2.	Supplying and laying of premier vinyl flooring of 2 mm thickness for the above cabin. The flooring as to be done in roll form/or in tiles forms. The flooring has to be done after thoroughly cleaning the floor and making the floor has even surface. The colour shade will be selected by the user. The contractor is requested to use proper Adhesive and the flooring must be free from defects and air pockets.	150 Sq.ft.	50	Sq.ft	7500

Item No.	Description of work	Quantity	Rate	Unit	Amount
	Supplying and fixing of false ceiling with ceiling tiles of size 2'-0"X2'-0"X12 mm thickness. The tiles are made of T.Wood particle board having high degree of Resistance to heat as per IS 1612-1960. The Teak Wood particle board is bonded with B.W.P. type Phenol Formaldehyde Synthetic Resin. The tiles are of ARCHITECTURAL, series. The sample tiles should be got approved before placing them. These ceiling tiles are to be placed on aluminium frame of sections as indicated below of 16 SWG thickness. 'T' Sections 37mm X 23mm X 1.5mm thickness Runner: 23 X 23 X 1.58mm thickness 'L' Angle 23mm X 23mm X 1.58mm thick 'L'angle. The height of the false ceiling will be 9'-0". The entire surface of the false ceiling should be painted with 2 coats of plastic emsolution paint. Total area = 100 Sq.ft.	100 Sq.ft	50	Sq.ft	5200
	WALL BRACKET TABLE: 675 X 750 height Fabricating and erecting at site table of size : 675 X 2990 X 750 mm as per the Drawing enclosed. The table top is to be provided with 18 mm Novopan sheet PLT. The top plank is supported by Teak Wood brackets support as shown in the Drawing. The support consist of 3" X 2' teak wood timber with a cross tie timber of T.W. The vertical timber is fixed on the wall with 5/16" coach screw at 3				

Item No.	Description of work	Quantity	Rate	Unit	Amount
	places and the horizontal support is screwed with the Novopan board of 18 mm thick with wood screws No:8, 2 1/2" long. There is no drawer for the table. All the edges are to be lipped with 1/8" thick Teak Wood reeper (or) to be pasted with decolite sheet of same colour, as decided by the users department. Colour shade will be decided by the user. The vertical brackets are to be fixed at 1m interval. All the exposed surfaces are polished with Sheenlac Wood Polish.				
	Size: (1) 675 X 2990 X 750 - 1No.	1 No.	2500	1 No	2500
	(2) 675 X 2315 X 750 - 1No.	1 No.	2000	1 No	2000

Total amount Rs.80,400/-

(Rupees eighty thousand and four hundred only)

ANNEXURE - III.5
PLATFORM & DRAINAGE DETAILS

CIVIL WORKS

For housing the bulk tanks and batch tanks, two mezanines (concrete platforms) are proposed. The bulk tanks platform shall house 7 tanks of chemicals whose solution required for 3 days is prepared and stored. These tanks shall be supported by side brackets (lugs) of the tanks on the mezanine floor. Hence a drawing showing the layout and cutout of the floor with staircase is provided. This unit is provided very close to control room and switch box. All the pumps required for the tanks shall be housed below the mezanine. Hence, all around the mezanine drain facility should be provided.

The btach tanks mezanine, shall also have seven tanks housed on the floor but supported on legs. This mezanine shall be provided in between the four drums, without distrubing / obstructing the normal functioning of the drums loading and unloading. Hence, the staircase is provided from in between two drums to the back side of the drums. The layout of the two mezanine and isometric view of the total system is enclosed for estimation purpose, while the scope of work is enclosed.

CONSTRUCTION OF R.C.C. PLATFORM FOR BULK TANKS OF SIZE 7.2 x 3.5 M

S.No.	Item of works	Quantity	Rate Rs.	Unit	Amount Rs.
1.	Earth work excavation in all kinds of soil including refilling and disposing of excess earth any where in the tannery			M^3	
2.	Sand in filling for foundation and flooring including watering and consolidation			M^3	
3.	Providing C.C. 1:4:8 (1 cement, 4 course sand, 8 graded store aggregate 40 mm size) for flooring and foundation			M^3	
4.	Reinforced cement concrete 1:1:5:3 (1 cement, 5 sand, 3 graded stone aggregate 20 mm nominal size) including form work, centering and shuttering excluding reinforcement bars and finishing with c.m.				
	a) Column Footings			M^3	
	b) Column			M^3	
	c) Beam and slab			M^3	
5.	Supplying, Fabricating and placing in position Fe 4:5 and M.S. bars for all RCC works including the cost of 20 guage G.I. binding wire			Kg	
6.	Cement platering 12 mm thick with C.M. 1:3 (1 cement, 3 fine sand) to all RCC works			M^2	
7.	Providing MS Ladder with MS angle, Flat, 'T' etc., including painting two coats over one coat of primer			Kg	
8.	Cement concrete flooring 52 mm thick with 40 mm C.C. 1:2:4 and 12 mm ironite top as per specification			M^2	

CONSTRUCTION OF R.C.C. PLATFORM FOR INTERMEDIATE TANKS OF SIZE 5.0 x2.5 M

S.No.	Item of works	Quantity	Rate Rs.	Unit	Amount Rs.
1.	Earth work excavation in all kinds of soil including refilling and disposing of excess earth any where in the tannery			M^3	
2.	Sand in filling for foundation and flooring including watering and consolidation			M^3	
3.	Providing C.C. 1:4:8 (1 cement, 4 course sand, 8 graded store aggregate 40 mm size) for flooring and foundation			M^3	
4.	Reinforced cement concrete 1:1:5:3 (1 cement, 5 sand, 3 graded stone aggregate 20 mm nominal size) including form work, centering and shuttering excluding reinforcement bars and finishing with c.m.				
	a) Column Footings			M^3	
	b) Column			M^3	
	c) Beam and slab			M^3	
5.	Supplying, Fabricating and placing in position Fe 4:5 and M.S. bars for all RCC works including the cost of 20 guage G.I. binding wire			Kg	
6.	Cement platering 12 mm thick with C.M. 1:3 (1 cement, 3 fine sand) to all RCC works			M^2	
7.	Providing MS Ladder with MS angle, Flat, "T" etc., including painting two coats over one coat of primer			Kg	
8.	Cement concrete flooring 52 mm thick with 40 mm C.C. 1:2:4 and 12 mm ironite top as per specification			M^2	

CONSTRUCTION OF DRUM DRAIN SYSTEM
(FOR FOUR DRUMS)

S.No.	Item of works	Quantity	Rate Rs.	Unit	Amount Rs.
1.	Earth work excavation in all kinds of soil including refilling and disposing of excess earth any where in the tannery			M³	
2.	Sand in filling for foundation and flooring including watering and consolidation			M³	
3.	Brick work for drainage system in C.M. 1:5 using Ist class bricks			M³	
4.	Cement plastering 12 mm thick with C.M. 1:3 to all over the drainage system.			M²	
5.	Cement concrete footing 45 mm thick with C.C. 1:2:4 to all over the drainage system			M²	
6.	Weld mesh drainage system of size 254 mm x 254 mm			M²	
7.	Cement concrete wall for drainage system up to 500 mm x 20 mm in P.C.C. 1:4:8			M³	

ANNEXURE - IV
TENDER DOCUMENT

Tender Document of the Contract for Installation and Commissioning of Chemical Tank Farm and Piping (UNIDO Project No: US/IND/90/244 (2))

1. Background Information

1.1 General

The United Nations Industrial Development Organization (UNIDO) Vienna, in cooperation with the Tamil Nadu Pollution Control Board (TNPCB) Madras, and Central Leather Research Institute (CLRI) Adyar, Madras. is launching a comprehensive programme of setting up a Common Effluent Treatment Plants (CETP) for cluster of tanneries in Pallavaram area near Madras city and implementation of Several environmentally cleaner technologies in tanneries at Pallavaram, Ranipet and Pernambut areas. This tender pertains to the implementation of ammonia free and cleaner wet tanning operations in a commercial tannery.

2.0 Ammonia Free and Cleaner Tannery Wet Operations

2.1 Objective

Introduction and implementation of CO2 deliming, process control systems for water and chemical additions and application of environmentally cleaner process/chemical options to reduce the pollution load in the waste waters generated in the process of leather manufacture.

2.2 Expected Output

Implementation and commissioning of a fully operational, appropriate Ammonia free and cleaner tannery wet operations in a selected tannery processing 1000-1500 Kgs. of hides/day. This program will be helpful in establishing its techno-economic viability under actual tannery conditions.

2.3 Scope of the Work

The contractor has to undertake following activities:

1. Fabrication, supply and installation of chemical tanks (T-1 to T-12 **Fig.1**) as per the specifications given in **Annexure I**, item 1.
2. Fabrication, supply and installation of chemical weighing system, (WB-01, **Fig.1.1**) as per the specifications given in **Annexure I**, item 2.
3. Installation of chemical and water piping (including fittings supports) network as shown in **Fig.1** for 4 drums (D-1 to D-4). CLRI will provide the new pumps/ control valves and other instruments (**Fig.1**) as shown in **Annexure-I**, item 4.
4. Supply and installation of manual valves as per **Fig.1**. The specifications are given in **Annexure-I**, item 5.

5. Fabrication and supply of mild steel structural flatforms. The details are given in **Fig.2**.
6. Participation in installation, testing and commissioning of the above facilities.

Following items fall outside the scope of this contractor:

a. Supply and installation of Control Modules

b. Civil Works and Drain Connections

c. Utility connections

d. Electrical wiring

2.4 Technology Inputs to be Provided by CLRI

2.4.1 Design Engineering Information

CLRI, Madras shall provide the following design engineering information to the turnkey contractor:

i. Layout

ii. Equipment Specifications

iii. Piping and Instrumentation Diagram

2.4.2 Other Technical Inputs

CLRI, Madras shall provide following inputs:

i. Technical inspections during project implementation

ii. Technical expertise to the contractor during commissioning

2.5 Responsibilities of the Contractor

i. Preparation of detailed engineering drawings of tank farm and piping based on the design engineering information provided by the CLRI, Madras

ii. Supply of all specified equipments (General list given in **Annexure I**), fabrication, erection and commissioning as per the design engineering information provided by CLRI, Madras

iii. Ensuring structural stability of all mechanical equipments and providing appropriate performance and post-implementation guarantees for a period of not less than one year after successful trial run

iv. Providing support to CLRI during training of the personnel of the user tannery in operation and maintenance of the equipments to be supplied by the contractor

v. Assistance in demonstration of process to the user tannery in three reproducible batches

2.6 Brief Description of the Suggested System

Fig.1 shows the piping and instrumentation diagram for the proposed demonstration facility consisting of the following:

- chemical tank farm
- piping-control valves
- instrument controlled water and chemical addition systems
- pH control systems
- CO2 handling system
- modified drum configuration
- data logging system/control modules.

Deliming, pickling, chrome tanning Neutralisation, fat liquoring and dyeing operations have been selected for implementing the environmentally cleaner options. The changing of chemicals and water will be monitored as per the process recipe and all the operations will be properly sequenced for control and data logging purposes.

2.7 Time Schedule for Project Implementation

The project will be implemented within 6 Months from the date of confirmation of the award by CLRI. The following is the approximate time schedule for major activities:

i. Equipment procurement and : 2 months from date of contract

supply

ii. Installation and commissioning : 1 month from the date of procurement and supply

iii. Demonstration : 1 month from the date of commissioning

3.0. Mode of Financing/Implementation

The cost of the proposed demonstration plant will be borne by the user industries and UNIDO. The payments to the contractor will be made directly by CLRI or through the user tannery on the advise of CLRI. The supply of all equipments by the turnkey contractor will be as per the specifications to be approved by CLRI/UNIDO. The access to the site of the host tannery site will be made possible by a bilateral agreement to be signed between CLRI and host tannery. The latter will arrange to execute civil works within the stipulated time schedule prescribed by CLRI/UNIDO. The payment to the contractor will be made in Indian Rupees.

Technical and Price Bids

The contractor has to submit technical and price bids separately in sealed envelopes with appropriate identification marks (Part I : Technical Bid; Part II : Price Bid).

5.0 Experience

5.1 The bidder must produce evidence of previous experience in carrying out similar jobs in tanneries.

5.2 CLRI/UNIDO will not be responsible for the loss of bid documents or delay in postal transit.

5.3 Price bids of only those offers which are judged as technically acceptable and fulfill other terms and conditions will be opened.

5.4 The Central Leather Research Institute (CLRI), Madras is the final decision making authority on all financial and technical matters.

6.0 Guidelines for Tendering

6.1 The scope of work mentioned in this document is to help the bidder in realizing the objectives of the proposed assignment.

6.2 The contract price quoted should take care of all types of supply and work that will be necessary for the completion of the proposed assignment.

6.3 The tender papers including **Annexure I** shall be complete in all respects and should be free from any ambiguity. Each page has to be stamped and signed.

6.4 The information and enclosures detailed below shall be submitted along with the technical bid.

i. A covering letter from the tenderer explaining the various contents of the tender and giving the name with attested signature in quadruplicate and detailed address of tenderer's representative who shall have the power to negotiate on behalf of the tenderer.

ii. Confirmation on validity of offer for six months from the date of opening of technical bids.

iii. Confirmation on time frame and mode of payment as stipulated in tender specifications, scope of work and special conditions.

iv. A detailed write-up on the organizational structure, experience, technical and financial capabilities of the bidding organization with supporting documental evidence.

v. The price bid shall contain the total lumpsum amount Rupees quoted for the complete project as well as major split up rates and unit rates along with the payment schedules.

vi. If any equipment has to be imported, it shall be indicated in the technical bid itself along with full justification. Import component should be as minimum as possible.

7.0 Other Terms

7.1 Supply of Materials

The contractor shall provide the detailed specification of all equipments, materials for approval of CLRI/UNIDO before supply. All equipments, materials, consumables, testing appliances, tools etc., necessary for the successful fabrication, erection, completion, trial run, operation and maintenance for the specified period shall be procured and provided by the contractor. No material required for such purposes will be supplied by CLRI/UNIDO.

8.0 Performance

8.1 The tenderer shall provide guarantee for a period of 12 months after successful trial operation for all the equipments, machinery, piping, installations etc. of the system against any manufacturing defect, defective materials, structural instability and/or substandard workmanship. Any defects found in the system workmanship or material used/supplied by the tenderer shall be made good by the tenderer at his own expenses within the guarantee period. The tenderer shall specify the type of financial guarantee to be provided towards assured performance of the system.

8.2 In the event of failure of any particular equipment/machinery which fails more than three times during the guarantee period, the tenderer shall have to replace the equipment with another equivalent make as approved by the CLRI/UNIDO and

manufacturer's guarantee shall be kept valid as mentioned in clause 8.1 of the tender document.

8.3 The total payment will be made once the equipment is tested for its performance after commissioning and installation.

8.4 The tenderer is liable for a penalty upto 10% of the tender value at the rate of 2% of the tender value for the delay of each and every month. The CLRI/UNIDO reserves the right to cancel the tender for the delay beyond 2 months and for any inferior quality of work partly or fully through other organizations at the cost and risk of the tenderer.

9.0 Special Terms and Conditions

9.1 The tenderer shall provide competent technical staff throughout the period of execution, trial operation and training period for periodical inspection and to implement the directions of CLRI/UNIDO.

9.2 All structural, mechanical, electrical, instrumentation and piping works and supplies etc. shall be protected from corrosion, heat, fumes etc. and shall conform to relevant Indian Standard Specifications, other rules, regulations, norms etc. prevailing at the period of execution.

9.3 The tenderer shall strictly follow the rules and regulations on labor and observe all safety measures against accident, damage, fire, theft, flood etc. at his risk and cost.

9.4 The rates quoted in the price bid shall be inclusive of all taxes, duties, royalties. freight, insurance etc. complete and subject to deduction of income tax, security deposit etc. at his risk and cost.

9.5 The tenderer shall provide detailed specifications and split up rates for each and every item of the structural, mechanical, electrical and other works and supplies.

9.6 The CLRI reserves the right to accept or reject partly or fully any of the offer of the successful bid during the execution, trial run and operation and maintenance period at their discretion without assigning any reasons whatsoever.

9.7 Any supply or item of work not indicated in the tender document, but necessary or incidental to the successful erection, operation, maintenance and performance of the Ammonia free and cleaner tannery wet operation shall be carried out by the tenderer without any extra financial commitment. The decision of CLRI will be final in the matter.

Specifications of Equipment

1. Chemical storage tanks with half open type lid

Quantity : 12 nos

Material of Construction : FRP

Thickness : 10-12 mm with Isophathalic Resin HSR 813 or equivalent

Operating Temperature : 65°C

S.No	Capacity (lts)	Qty.	Dia (mm)	Length (mm)	Dished Volume	Nozzles on the top lid
T_1	150	1	500	750	10.7	2 nos (25 mm)
T_4T_7 T_8T_{12}	250	4	600	850	18.6	2 nos (25 mm)
T_5	500	1	800	900	44.0	2 nos (25 mm)
T_2T_3 T_6	750	3	900	1100	62.6	3 nos (65 mm, 50 mm, 25 mm)
T_9T_{10} T_{11}	1000	3	1000	1250	89.5	3 nos (65 mm, 50 mm, 25 mm)

All the storage tanks should have 25 mm nozzle at the bottom.

The storage tanks should be provided with suitable brackets, turbine stirrer with pitched blade made of SS315 and mounted on the top of the tank. Please see **Fig.1** for details.

2. Chemical weighing system comprises of a load cell, SS 316 bucket and suitable support and a propeller type stirrer with variable speed motor

Type of load cell	:	Strain Gauge (corrosion resistant)
Capacity	:	250 kgs, accuracy ± 100 Gms
Nominal capacity of the bucket	:	250 lts
Material of construction	:	SS316

Please see **Fig.1.1** for details. The entire system should be enclosed in suitable SS316/FRP enclosed.

3. Piping and Fittings

Material of Construction	:	PVC/FRP
50 mm ID	:	300 ft long
50 mm ID	:	50 ft long
25 mm ID	:	300 ft long
50 mm ID (GI Pipe)	:	300 ft long

These are approximate lengths. The length of the pipelines may vary at the time of installation. The piping isometrics have to be prepared by the contractor. All the manual and control valves and instrumentation will be provided by CLRI/UNIDO and the contractor has to integrate the piping and instrumentation as shown in **Fig.1** and the

job has to be executed under the supervision/guidance of CLRI as per the P&I diagram shown in **Fig.1**.

The contractor may quote the piping per foot of pipe length.

4. Manual Gate Valves

GI Valves Size 2"0 (for water service)	:	21 nos
PVC/FRP Valves size 1"0 (for chemical Service)	:	100 nos

5. Mild Steel Structural Flat Forms

Quantity	:	3 nos

ANNEXURE - V
REPORTS OF VISITING EXPERTS

Restricted

US/IND/90/244/11-52
Austria, 1995
English

Assistance in the Implementation of *CLEANER LEATHER TECHNOLOGIES* for Tanneries in the State of Tamil Nadu / India

US/IND/90/244/11-52

Technical Report: Review and Evaluation of Already Implemented Cleaner Technologies, Continuation of Trials on Carbon Dioxide Deliming and Pickle - free Chrome Tannage

Prepared for the Government of India by
United Nations Industrial Development Organization
(UNIDO)

Based on the work of Karl Heinz MUNZ,
Consultant in Cleaner Leather Technologies

Backstopping Officer Jakov BULJAN
(Agro-based Industries Branch)

UNIDO
United Nations Industrial Development Organization
Vienna - Austria
1995

INDEX

	Page
Abstract	1
1. INTRODUCTION	2
1.1. Background to the Project	2
1.2. Summary of Activities	2
1.3. Conclusions	3
1.4. Background Information	3
1.5. Recommendations	5
2. ACTIVITIES	7
2.A.: MEETINGS	7
2.A.1.: Mission Preparatory Meeting	7
2.A.2.: Meeting wth UNIDOs O & M - Consultant	7
2.A.3.: Meeting with CLRIs Mechanical Staff	7
2.A.4.: Final Meeting with CLRI	8
2.A.5.: Meeting with Mr. A. SAHASRANAMAN	8
2.B.: VISITS	9
2.B.1.: Visit to M/s General & Industrial Leathers, Pallavaram	9
2.B.2.: Visit to Arafath Leathers, Pallavaram	9
2.B.3.: Visit to Pallavaram CETP	10
2.B.4.: Visit to Tejoomals Tannery, Pernambut	10
2.B.5.: Visit to Pernambut's CETP	10
2.B.6.: Visit to KH - Group, Ranipet	11
2.B.7.: Low Sulphide Unhairing	11
2.C.: TRIALS	12
2.C.1.: Deliming Trials at Tejoomals	12
2.C.2.: CLRIs Deliming Trials at Tejoomals	13
2.C.3.: Comparative Trials with Computer - Aided Auxiliary Addition	14
2.C.4.: Trials on Pickle - Free Chrome Tannage	14

3. RECOMMENDATIONS 17

3.A.: Chrome Recycling 17
3.B.: Desalting Drum 17
3.C.: Deliming with Carbon Dioxide 17
3.D.: Computer Aided Auxiliary Addition 18
3.E.: Low Sulphide Unhairing 18
3.F.: Utilization of Tannery By - Products 18
3.G.: Strategies for the Implementation of Cleaner Technologies 18
3.H.: Pickle - Free Chrome Tannage 19
3.I.: Suggestions for Follow - Up Projects 19
3.K.: Information for the Tanners 20

Annexes

Annex 1: Copy from „HINDU"
Annex 2: CLRIs Programme for the Expert's Mission
Annex 3: Scheme of HUeNI - Drum
Annex 4: Report on Joint Trials at Tejoomals Tannery
Annex 5: Report on CLRIs Trials at Tejoomals Tannery
Annex 6: CLRIs Contribution to LERIG - Meeting 1995
Annex 7: CLRIs Report on Pickle - Free Chrome Tannage

Abstract

General objective of this 3-weeks-mission (2 weeks field, 1 week home based) was to communicate with the Central Leather Research Institute (CLRI) in order prepare a critical review of the application (working procedures) and the results of the implementation of Cleaner Technologies, including the introduction of automated process control on industrial scale. Furthermore assistance to the CLRI staff in carrying out pilot scale technical tests on pickle - free tanning, including the evaluation of the first results, had to be given.

Within the last year the environmental situation in some Indian tanneries has improved, although it cannot be considered as fully solved. While some implemented cleaner technologies are at the state of art (chrome recovery), others already have been installed, but do not work in continuos cycles (mechanical desalting, computer aided addition of auxiliaries). Extended trials in industrial scale have the tanners already convinced that both procedures will - once fully implemented - either reduce effluent loadings or/and support the to improve the leather quality by process control.

The low sulphide unhairing cannot be carried out at the time, as enzymes are not available at the moment. The Indian counterpart has insured that enzyme production has already be started, and so intensive industrial scale trials on this procedure should start in September 1995.

The deliming with Carbon Dioxide has been tried several times in industrial scale, and - as results are satisfying - it is to expect that this process will be fully implemented at some tanneries within one years time.

As the Indian authorities have given pressure to all Indian tanners in order to enforce the fulfillment of effluent restrictions, tanners have become clearly aware of effluent treatment, its costs and cost savings, which can be achieved with cleaner technologies. This has been indicated by many requests on cleaner technologies to CLRI, and, therefore, a much higher willingness of tanners in order to implement eco - friendly technologies is to expect.

During the mission, trials on pickle - free tannage have been continued at CLRI. For skins the technology could be elaborated, but still some fine - tuning will be required. Once this has been done, also trials with this procedure on lime splitted hides should be carried out.

1. INTRODUCTION

1.1. Background to the Project:

The author, Karl Heinz MUNZ, was appointed as specialist in "Cleaner Leather Technology (beamhouse)" on the project

US/IND/90/244/11-52
"Cleaner Leather Technology"

in order to critically review the application of implemented less polluting beamhouse processes, especially deliming with Carbon Dioxide (CO_2) to the leather industry in Tamil Nadu State of India. Furthermore he should assist the CLRI staff in carrying out tests on pickle-free tanning and evaluate the first results.

1.2. Summary of Activities:

This report describes the main activities of UNIDO - expert in cleaner leather technology, Karl Heinz MUNZ, during his two-weeks-mission in the State of Tamil Nadu / India. This activities were

- to communicate with CLRI in order to ensure/ confirm that the ultimate recipient of technical assistance (TEJOOMALS Tannery) is producing and ready for the consultants mission, equipment operational, chemicals required procured and staff of appropriate background available.

- critically to review the application and results achieved so far of introducing automated processes control with emphasis on industrial scale deliming of pelt using Carbon Dioxide. In addition possible deficiencies in overall technologies should be identified and advice on improvements should be given.

- to evaluate the operations on other cleaner technology units (mechanical desalting, low sulphide unhairing, chrome recycling) and to suggest possible actions to be taken until the end of the project life as well as an appropriate follow up.

- to assist the CLRI staff in carrying out tests on pickle-free tanning at the pilot scale level and to evaluate the first results.

1.3. Conclusions:

- Although the situation seems to improve (especially the Pallavaram - Cluster of tanneries), the Indian leather industry is still suffering from a lack of pollution reducing installations as well as less polluting procedures.

- As the authorities (Government) has already started to enforce existing requirements, this should be fully utilized by tanners, pollution control organizations and local authorities in order to continue the implementation of less polluting leather processing methods. CLRI will support all measures with technical assistance.

- While the chrome recovery and desalting procedures have already been developed to a state ready to implement in other tanneries, deliming with Carbon Dioxide requires more trials in technical scale. These trials not should not only focus the deliming action, but moreover the reduced effluent loading should be considered.

- Industrial scale trials on hairsaving liming should be started as soon as enzymes are again available. With these trials not only the reduction of sulphides in effluents will be achieved, but moreover the reduced oxygen demand (and so energy saving due to reduced aeration) will be the main advantage.

- The computer monitoring of pH and the computer aided addition of auxiliaries in TEJOOMALS tannery is now ready for constant application. The TEJOOMALS - staff has familiarized with the computer system and is now able to utilize the facility.

- As soon as hair saving methods will be applied in industry, the question of hair utilization will occur. So appropriate methods in order to utilize the by-product „hair sludge" have to be developed.

- As many tanners complain about problems in sludge disposal, a concept for the utilization of other by-products (fleshings, trimmings, shavings) has to be developed. In this respect, for tannery clusters, a centralized utilization is recommended.

1.4. Background Information:

Extract from „The Hindu" (Friday, July 28th, 1995)

The Indian Supreme Court has fixed a deadline with July 31st, 1995 (Order given on May 1st, 1995) to complete the setting up of effluent treatment plants either individually or collectively for 496 out of 553 tanneries in North Arcot - Ambedkar district (Tamil Nadu State). This measure cannot be met by a majority of 445 of them as the Common Effluent Treatment Plants (CETP) are still in various stages of progress. The remaining 57 tanneries, spread over the entire district, were ordered closed for their failure to install and commission the ETPs despite various court orders.

Of the 496 tanneries covered by the court's dead line, 51 tanneries contained in Statement I filed before the court by the Tamil Nadu Pollution Control Board (TNPCB) had put up individual ETPs while remaining 445 contained in Statement II were to be linked with CETPs. The 57 tanneries ordered closed were contained in Statement III of the TNPCB. These tanneries had neither set up individual ETPs nor joined any CETP.

The Tamil Nadu Government is now gearing itself to move the court foi an extension of the deadline for these 445 tanneries covered by CETPs. The Government found during the review in June that „ the current rate progress in the execution of the CETPs was inadequate and the plants are not likely to be commissioned before July 31 unless matters are taken up on warfooting".
At an official review meeting in Madras on June 12 under the presidentship of Mr. C. Ramachandran, Industries Secretary, it was decided that the Director of Industries and Commerce would coordinate with various organizations such as Tamil Nadu Leather Development Corporation, the TNPCB, CETPs and individual tanners, as „a lack of coordination among the various agencies" was identified as the main problem. The Director of Industries and Commerce was asked to prepare an action plan to complete the work on CETPs „as fast as possible".

The meeting explored the possibility of extending the facility of CETPs to the 57 closed tanneries who were non -members. The Central Leather Research Institute (CLRI) was requested to conduct immediately a study to examine the feasibility of including all 57 tanneries in the nearby CETPs either by provision of pipelines or through transport of effluents by tankers on the site of the CETPs.

(.....)

The problem of delay in the release of subsidy by the State Government hindering the work is now no longer there since the Government has started expediting the sanction of the subsidy following the directions of the Supreme Court in its May 1st order. (....)

(see Annex 1)

Indian tanneries discharge at the moment about 50.000 cbm of effluent per day ,but only some large and mid scale industries had already implemented an effluent treatment. and amongst them only a few carry out primary and secondary treatment processes. Others, small and rural tanneries, which have in discharged their waste water without any previous treatment, have been closed by Government orders.

With this official pressure, the readiness of Indian tanners to implement cleaner technologies, to build their own ETP or to connect their factory with CETPs, has increased tremendously. CLRI now is more often requested for expert opinions and advises.

Beside these effluent problems, in near future another problem for Indian tanners is to expect: During the expert's visits many tanners complained about a lack of dumping sites, and so about raising disposal costs for tannery by - products. (The former utilization of fleshings and trimmings by rural people is constantly decreasing).

Both problems, the present strict enforcement of requirements on discharged effluents and the expected problems with waste disposal, should support CLRI in the progressive implementation of cleaner technologies and with the development of appropriate methods for the utilization of tannery by - products.

One of the main problems of Indian tanneries is the salt loading in effluents. Even when all salt reducing measures will be taken, the problem will become reduced but not solved. So at the moment a discussion has started to move all tanneries of Tamil Nadu State to a new cluster near the sea side. Then effluents (after secondary treatment) can be discharged to the sea, and so the salt content will be no longer a problem.

1.5. Recommendations:

Compared to the present expert's mission last year, progress in effluent treatment and in implementation of cleaner technologies is evident. However, further activities are necessary, and it should be made good use of the actual pressure from the Government in order to continue with environmental protective measures.

- Both, chrome recovery plant and desalting drum, have already been implemented and are utilized during regular production. So, both plants are ready for presentation to the tanners, and it is to recommend that brochures with working principles and instructions, investment costs and feasibility considerations should be elaborated and distributed among interested tanners.

- Carbon dioxide deliming is now ready for industrial implementation, but only feasible for bigger tanneries. If once the ammonia - free deliming is constantly applied in one or two tanneries (Tejoomals and KH - Ranipet), other tanneries will probably follow.

- The computer monitored and aided auxiliary addition at Tejoomlas tannery is ready for constant run in regard of performance and familiarization of the staff. Although some more small installations and adaptations (time-depending rotation of drum, gear boxes for drums, valve control for gas insertion) could lead to further improvements.

- Enzymatic unhairing seems - as soon as the enzymes are available again - ready to be implemented into skin tanneries, for bovine tanneries some more trials should be carried out in order to make sure a complete hair removal.

  As main advantage of this procedure the reduction of oxygen - demanding effluent loadings should be announced, the reduction of sulphides in effluents should only be claimed as positive side effect.

- As many tanners apprehend a shortage of dumping sites in future, utilization methods for all kind of tannery by-products (fleshing and trimmings, but also hair sludge and shavings) should be elaborated.

- The original high salt loading of receiving streams is expect to raise limitations on salt loadings of tannery effluents. Beside desalting of raw material the pickle - free chrome tannage can help to reduce this problem. For skins and lime - splitted hides the pickle - free procedure has basically been developed, but still fine tuning is necessary. So it is to recommend to carry out more trials in semi - technical scale in order to make the procedure ready for industrial implementation.

- In India it is very common to carry out soaking and liming in paddles. As this requires high float relation, for new tanneries the installation of drums for beam house processes should be advised.

2. ACTIVITIES

2.A. Meetings:

2.A.1.: Mission Preparatory Meeting:

This meeting was held at CLRI, Madras, on July 27th, 1995. Following persons were participating:

K. PARTHASARATHI, asst. director of CLRI, head of tannery division

C. MURALIDHARAN, scientist at CLRI

Dr. S. GUPTA, scientist at CLRI

K.H. MUNZ, UNIDOs expert in cleaner technology

During this meeting the Indian counterparts gave a short survey on the present situation. Furthermore it was agreed upon the programme for visits and the trials at CLRI. A copy of the programme is given in

Annex 2

2.A.2.: Meeting with UNIDOs O & M Consultant

On July 28th, 1995 the expert met Dr. J. HANNAK in order to discuss the present situation, Dr. Hannak's impression and to exchange general views of the project.

2.A.3.: Meeting with CLRIs Mechanical Staff

On July 31st, 1995 Mr. P.G. RAO, Mr. K. PARTHASARATHI (both asst. directors of CLRI), Mr. MURALIDHARAN and the UNIDO - expert, Mr. MUNZ, discussed about problems in gas insertion.

Although at KH, gas has to be inserted into a closed HÜNI - drum with integrated recycling system and filling level above the axle, Mr. P.G.Rao does not expect any problems with gas pressure, except when the feeding axle has too small diameter, problems might occur. Mr. P.G. Rao will visit KH in order to discuss the adequate gas insertion system. In

a technical plan of the HÜNI - drum is attached.

It was also agreed that CLRI will develop an on/off - valve that - once connected with pH - control in the drum - will clearly reduce the gas consumption.

2.A.4.: Final Meeting with CLRI

On August 2nd, 1995 Mr. PARTHASARATHI, Mr. MURALIDHARAN and Mr. MUNZ reported to Dr. K.V. RAGHAVAN about duties, trials and implementation tests carried out during missions. In addition, Mr. Munz reported about his impression on other cleaner technologies.

Dr. Raghavan explained ongoing duties of CLRI, regarding the implementation of less polluting technologies:

- At Kampur Cluster 3 tanneries will implement the computerized system as developed at Tejoomals, including Carbon Dioxide Deliming. While in one tannery the implementation has already started, the plants for two other tanneries is just designed and lay-outet.

- In Bangalore, 14 tanneries will install a joint chrome recycling plant as already implemented at General Leathers, Pallavaram.

- At ASIAN DIET PRODUCTS Ltd., Gurgaon, a lime splitting machine for heavy hides will be installed. The grain split should re converted into leather, while the flesh split (after deliming) will be utilized for pet chewing articles (chewing bones, sausages, etc.).

The total investment will be Rs 18 crores (= US $ 600.000,-). While 60 % will be funded by the Indian Government, other 40 % will be invested by the tanneries.

2.A.5.: Meeting with Mr. A. SAHASRANAMAN, IAE

On August 3rd, 1995 the expert, Mr. Munz, met the Manager of NLDP (National Leather Developing Programme, and Dr. S. RAJAMANI (deputy director, head of CLRIs environmental laboratory).

After the expert gave his impressions on the environmental situation of tanneries in Tamil Nadu State, a discussion on further procedures took place. In this discussion, Mr. Sahasranaman pointed out that the implementation of cleaner technologies also should take place in small to medium scale tanneries. Otherwise visiting tanners might become afraid to have to implement sophisticated and expensive systems like in Tejoomals or in KH - Group.

2.B. Visits

2.B.1.: Visit to M/s GENERAL & INDUSTRIAL LEATHERS, Pallavaram

On July 24th, 1995, Mr. PARTHASARATHI and Mr. MUNZ visited the tannery, where the desalting drum was implemented. The drum is still in good conditions, but was not often used during the last months. Reason for this is, according to Mr. THOMAS CHANDY (owner of the tannery) the fact that - due to environmental restrictions by the Government - he is mostly working imported (European) wet blues, which cost him around DM (German Mark) 120,- for a hide of approx. 40 sqft. Secondly, at the moment it is low season and most of the tanneries in Pallavaram Cluster work with about only one fourth of their capacity. So Mr. CHANDY explained that he will fully use the drum as soon as more salted domestic hides and skins will be available, and he expects this for early September. He also declared his willingness to demonstrate desalting to other interested tanners.

Mr. PARTHASARATHI and Mr. MUNZ explained once more the advantages of desalting to Mr. CHANDY, which cannot mainly be seen in the saving of expenses for salt, which can be recycled. It has to be more emphasized that the weight of raw hide will be reduced by about 10 % by desalting. As float relations for soaking and liming will be related to the raw hide weight, water savings of about 10 % will be achieved.

The re-use of salt should be exclusively for pickling, but due to impurification (hairs, manure, etc.) the salt solution should be filtered before being utilized. Furthermore, as the recycled salt will have higher moisture than the fresh one, the concentration of the brine has to be controlled by density.

2.B.2.: Visit to ARAFATH LEATHERS, Pallavaram

On July 24th, 1995, Mr. PARTHASARATHI and Mr. MUNZ visited the chrome recycling plant of this tannery. Mr. K.M.S. SHAMSUDEEN, owner of the tannery, proudly presented this plant. It consists of a storage tank with 8 cbm capacity (i.e. 2-day-capacity), where - after screening - all final liquors of the tannage as well as from the sammying press will be collected (average pH = 3,8). Then 0,4 % MgO (Magnesium Oxide) are added and dissolved by stirring for 2 hours (final pH = 7,8 - 8,0). After 6 hours for settling the supernatant is removed and H_2SO_4 (Sulfuric Acid) is added under stirring.

This chrome - liqour has an average chrome - content of 0,25 kg per liter, and will be used - together with fresh chrome - for the subsequent tannage. The supernatant is applied for presoaking. Mr. SHAMSUDEEN seems very satisfied with the chrome recycling plant and calculates with a pay-back-period of 3 years. As he is convinced on the advantages of the plants, he sometimes invites young tanners in order to demonstrate them the chrome recycling.

As he sees problems in sharing the plant with other tanners, he will set up his own recovery plant in his new tannery.

2.B.3.: Visit to Pallavaram Tanners Industrial Effluent Treatment Plant Company Ltd.

This visit also took place on July 25th, 1995. The general impression - compared to the expert's last year visit - shows good improvements, as streets are no more flooded by any tannery effluents. The general manager of the CET, Col. P. GANESAN, explained that meanwhile most of the tanneries have already been connected with the CET, and the few remaining are expected to do so within a few months. Generally the plant works with good efficiency. Although no analytical data's were available, the general impression of the plant seems to certify Mr. GANESANs expressions.

2.B.4.: Visit to TEJOOMALS Tannery, Pernambut

Visit and trials took place on 26th and 27th July, 1995. CLRI - representatives were Mr. PARTHA-SARATHI and Mr. MURALIDHARAN; Tejoomals was presented by Mr. S. RAVICHANDRIAN, Mr. N. SUTHAGAR, Mr. RAJAGOPAL and Mr. M. SADARKA.

At the moment 4 drums are already connected with the computerized chemical supplying system, and, although the system is not used in regular production, improvements are obvious. One is that the tannery's staff has fully familiarized with the system and no handling problems are to expect, when the system fully will go on stream once.

Secondly, as pH - displays are working for all 4 drums, also simple workers are adding chemicals more careful, and so - regarding to the technical manager - within the last months quality improvements have been achieved.

The report on deliming trials as well as on previous CLRI - trials on wet finishing, are given in „Chapter C".

2.B.5.: Visit to Pernambut's CET

Close to Tejoomals, there is the new CET for Pernambut tanneries. At the day of visit (July 27th, 1995), final works (painting, road works, etc.) were still going on, as with August 1st, 1995 the plant has to go on stream. In the first phase, only 3 tanneries (among them Tejoomals) will be connected with the CET, others will follow as soon as possible.

2.B.6.: Visit to KH - Group Tannery, Ranipet

On July, 28th 1995, Mr. PARTASARATHI and the UNIDO - Expert, Mr. MUNZ visited KH - Tannery in Ranipet. Mr. J. RAO (Technical manager of KH) and Mr. J.K. KHANNA (Technical consultant) showed the whole tannery to their visitors, which doubtless is on international standard.

At the moment KH is mostly interested to implement Carbon-Dioxide-Deliming. Their problem is, to carry out deliming in closed HÜNI - drums (volume about 16 cbm) with float recycling and filter installations. As there is no hollow axle and filling capacity is usually above axle level, gas insertion cannot be carried out as usual. (also see **2.A.3.**)

In a discussion it was agreed that KH will find out whether insertion via the feeding pipeline will be applicable and - as the axle will be below float level - whether any special installations for the insertion under higher pressure will be required.

As Mr. HASHIM, owner of KH, has seen the deliming system in European tanneries, he is absolutely interested in implementing and will support these activities.

2.B.7.: Low - Sulphide - Unhairing

During the expert's mission no visit of the implemented hairsaving system could take place. Main reason is that no enzyme is available at the moment. Both, Dr. Raghavan and Mr. Parthasarathi stated that the CFTRI (Central Food and Training Research Institute) at Mysore has already started with the enzyme production, and the first batch should be available by middle of August. Then intensive implementation trials will be carried out.

Secondly, according to Dr. Hanak and Dr. Raghavan, HAARTY - LEATHERS, where this procedure has already been implemented, is facing internal problems, which should be solved within months time.

2.C. Trials

2.C.1.: Deliming Trials at TEJOOMALS

These trials were carried out during the expert's stay at the tannery, using the dosing system and comparing in parallel drums between conventional deliming and Carbon-Dioxide-Process.

Starting material: Cow hides (20 kg), soaked and limed and fleshed according to Tejoomals common procedure.

Drum loading: 102 sides per drum (i.e. 1.035 kg)

The exact procedures for

- deliming and bating
- pickling
- chrome tannage
- neutralization
- dyeing
- retanning and
- fat liquoring

is given in

Annex 4

General remarks:

With Carbon Dioxide in thick portions no fully deliming could be achieved. According to Tejoomals tanners, this also happens at the conventional process. First of all, as extended pickling (over night) is carried out, traces of lime will be removed during this step. As pickling is carried out under constant drum rotation, often loosen grain occurs. This will be avoided when also drum rotation will be connected with the computer, as then it will be possible to rotate only for a few minutes per hour.

Between gas - delimed and conventional delimed pelts no difference in chrome - penetration was observed. Moreover, wet blues from the Carbon Dioxide - process show tighter and cleaner grain.

Although the gas consumption was lower than the amount of ammoniasalts, (2 % CO_2 vs 2,5 % Ammonia salts), gas insertion has not been optimized so far. It is to suggest to link pH -

monitoring with an on/off - valve, and then it is to expect that gas consumption will be reduced to about 1,2 % CO_2.

According to Mr. P.G. Rao (CLRI), the installation of an pH - regulated, computer controlled valve will be possible without any problems (see 2.A.3.).

2.C.2.: CLRIs Deliming Trials at TEJOOMALS

From July 19th - 21st, 1995, CLRI has carried out comparative trials on deliming, tanning and wet finishing procedures. Starting material were cow hides (average weight 10 - 14 kg/ side), while one batch was delimed with Carbon Dioxide, the other was processed in the common way. The exact procedures are given in CLRIs attached report, shown in

Annex 5

While for conventional deliming 4 hours, 45 minutes were spent, deliming with Carbon Dioxide took 4 hours only, with comparable results. Consumption on ammonia salts was 2,5 %, while only 1,5 % CO_2 were applied, in both batches fully deliming could not be achieved, but was finished by extended pickling.

In the Annex, 2 graphs: pH vs time are attached. Both show the comparison between manual and computer controlled chemical addition. It is clear to see that the computer aided system leads to a more uniform feeding, and so a better leather quality can be expected.

All procedures, common as well as with Carbon Dioxide, were carried out with computer aided auxiliary addition (diagrams are shown in the annex). According to Mr. MURALIDHARAN, in the final products no visual differences were recognized.

This report also contains comparisons of analytical results from both, the conventional and the Carbon-Dioxide process. The following tables show these comparisons (all parameters, except pH, are expressed in mg/l = ppm):

Spent Liquors from Deliming

	Ammonia free deliming	Conventional deliming
pH	7,14	8,17
Alkalinity	2.000	3.200
BOD	1.380	2.100
COD	2.446	4.170
Total solids	9.965	23.195
Chloride	1.357	5.557
Sulfate	1.248	3.942
Ammonia	514	1.856

Combined Effluents
(raw hide to wet blue)

	Cleaner Processing	Conventional Processing
pH	10,13	10,35
Alkalinity	1.800	2.400
Total solids	25.240	28.020
Chloride	5.922	7.402
Sulfate	1.069	1.530
Ammonia	84	169
Chrome	534	702

2.C.3.: Comparative Trials with Computer - aided Auxiliary Addition

During the last year, CLRI has carried out a series of trials in order to compare **Ammonia Free and Cleaner Wet Tanning Operations** with the conventional process. Additional scope of these trials in technical scale was to familiarize the TEJOOMALS staff with the computer system.

The results were presented during the „**LERIG - 30th Leather Research - Industry Get - Together 1995**" from January 28th - 30th, 1995 as part of „Eco - Sustainable Leather Teçhnologies" at CLRI. A copy of the proceedings is given in

Annex 6.

According to this publication, not only reduction of effluent loadings could be achieved with the ammonia free wet processing, but also improvements in crust - quality in regard of functional and aestethic properties were observed. In addition, by computer controlled chemical addition, savings of retannins up to 20 % could be achieved (also see *Annex 5*).

2.C.4.: Trials on Pickle - free Tannage

On July 31st and August 1st, 1995 trials on pickle - free chrome tannage were carried out in CLRIs tannery. In contradiction to last year, a fuctioning manifold system with gas heater was available. Starting material for all trials were fleshed goat skins, starting weight of 5 pieces at times ranged between 5 and 6 kgs. The following table shows a comparison, the experimental results and the different procedures:

Comparison
of pickle free tannage with conventional tanning

Parameters	Conventional process	Trial 1	Trial 2
% BCS* offered	8,0	7,0	7,0
total duration of de-liming and tanning (hrs)	5,2	2,4	4,0
% HCOOH offered	0,5	0,2	0,3
% H_2SO_4 offered	1,0	----	----
% NaCl offered	8,0	2,0	2,0

Comparison
of wet blues

Parameters	Conventional process	Trial 1	Trial 2
General appearance	better	good	better
Color (Uniformity)	light blue	greenish	greenish surface, blue cross section
Stitch tear strength	slightly better	good	good
Grain appearance	smoother, not drawn	drawn and rough	little tendency for drawn grain
Fullness	full	full	full
% Cr_2O_3 fixed	4,5	4,3	5,2
chrome content in residual bath	normal	better	best

BCS* = basic chrome sulfate

CLRIs report of these trials is given in

Annex 7

Procedures

	Conventional process	Trial 1	Trial 2
Washing for 15 minutes	200 % H_2O	200 % H_2O	200 % H_2O
	drain	drain	drain
Deliming + Bating	200 % H_2O 1 % NH_4Cl (15 minutes) 1 % Bate (45 minutes)	200 % H_2O 20 l/min CO_2, (after 15 min.) 1 % Bate (total 60 min.)	200 % H_2O 1 % NH_4Cl (15 minutes) 1 % Bate (45 minutes)
	fully delimed, drain	fully delimed, drain	fully delimed, drain
Washing for 10 minutes	200 % H_2O	100 % H_2O 0,1 % HCOOH pH = 4,8	200 % H_2O 0,1 % HCOOH
	drain	drain	drain
Pickling	80 % H_2O 8 % NaCl (15 minutes) 0,5 % HCOOH (2 x 10' + 10') 1 % H_2SO_4 (4 x 10'+ 50') pH = 2,5 drain 50 %		
Chrome tannage	4 % BCS* (30 minutes) 4 % BCS* (40 minutes) 50 % H_2O (10 minutes) 1 % $NaHCO_3$ (2 x 10') 1 % $NaHCO_3$ (3 x 10'+ 30') pH = 3,5 0,5 % $NaHCO_3$ (30 minutes) pH = 4,0	100 % H_2O 2 % NaCl 20 l/min CO_2 (15 minutes) 7 % BCS* (60 minutes) CO_2 stopped pH = 3,5 0,5 % $NaHCO_3$ (3 x 10'+ 40') pH = 4,0	100 % H_2O 2 % NaCl (15 minutes) 0,2 % HCOOH 20 l/min CO_2 (45 minutes) 4 % BCS* (30 minutes) 3 % BCS* (50 minutes) CO_2 stopped 0,5 % $NaHCO_3$ (4 x 10'+ 40') pH = 4,0
	drain + pile	drain + pile	drain + pile

3. Recommendations

3.A.: Chrome recovery

This procedure, already implemented in ARAFATH Leathers, is working in constant use and is fully satisfying for its employer. According to Dr. Raghavan's statement, for a tannery cluster in Bangalore, a joint chrome recovery plant is planned.

As discussed with Mr. Sahasranavan, it seems to be necessary, to have one or two more simple demonstration plants for medium scale tanneries (similar to Arafath). Such smaller plants can convince owners of remote tanneries that neither a big and sophisticated plant is necessary nor the handling will be too complicated, as it might happen with joint (big) plants.

It is to recommend that CLRI will publish a short leaflet with the working principles and a feasibility study of the plant, based on the current experiences of Arafath tannery.

3.B.: Desalting drum

Also this procedure has been already implemented, and - according to Mr. Chandy, works with good sufficiency. In the expert's opinion, either desalting with a drum or - for small scale tanneries - mechanically, is the only possibility in order to reduce salt laodings of the effluents. Therefore, more demonstrations of this procedure would be useful.

Also for desalting, it is to recommend to CLRI to publish a short leaflet with the working principles and a feasibility study of the plant, based on the current experiences of General & Industrial Leathers. Such a leaflet should especially emphasize that - as water consumption for beamhouse processes are related to the raw hide weight - desalting will reduce the required volume of water for soaking and liming by about 10 %, and this will make the process feasible.

3.C.: Deliming with Carbon Dioxide

Trials in technical scale at Tejoomals tannery have shown that this process works satisfying, even if hides are not lime splitted. Even when deliming duration takes a little longer than the conventional procedure, comparative analysis of the effluents have indicated less loading of part streams, when Carbon Dioxide is applied.

In order to reduce the gas consumption, it is to recommend for Tejoomals to connect the gas insertion (manifold is available) with pH - monitoring and to combine the inserting unit with a control valve. So it will be possible to reduce the gas consumption furthermore, and thereby will make the process more feasible.

Since KH - Group tannery in Ranipet is very interested in implementing the ammonia free procedure, it is to recommend to CLRI to start with trials as soon as possible.

3.D. Computer aided auxiliary addition

The computer - monitored system at Tejoomals is now fully implemented and ready to be applied in constant run, also the tannery staff seems to be familiar with the system. Since at Tejoomals many procedures (pickling, retanning) are carried out under constant drum rotation over night, leathers show often loosen grain.

For most of the procedures, constant drum rotation is not required. Therefore it is to recommend to connect the drum actuation with a time switch and control the drum rotation by computer. This measure should help to avoid loosen grain.

3.E.: Low sulphide unhairing

As soon as the enzyme will be available again, intensive trials for unhairing of hides should start. According to the expression of CLRIs scientists, unhairing of skins can be carried out with enzymes only, while for full unhairing of hides still small amounts of sulphide is required. On the expert's opinion, sulphide (when applied in small quantities) is not a real problem, on the contrary the hair recovery, and so the reduction of oxygen - demanding effluent loadings, should be emphasized as the advantage of this procedure.

Therefore it is to recommend that analysis of effluents should consider the reduction of COD (chemical oxygen demand), when enzymes will be applied. In a feasibility study savings of electric energy due to reduced aeration should be considered.

3.F.: Utilization of tannery by - products

During the expert's mission many tanners emphasized their problem with waste disposal. So, it is necessary to develop methods for the utilization of the by - products: fleshings, glue stock, trimmings, shavings and hair sludge from enzymatic liming processes (also see: 3.I.: Proposals for follow - up projects).

3.G.: Strategies for the implementation of cleaner technologies

As discussed with Mr. Sahasranaman, new demonstration plants for cleaner technologies, especially for chrome recycling and desalting, should be not only implemented into big and modern tanneries with very sophisticated facilities (e.g. computerized chemical addition), but also in medium sized, not so good equipped tanneries.

It is to apprehend, when such demonstration plants will be only situated in modern tanneries, tanners from rural places might be afraid to have to implement similar (expensive) systems, and therefore will refuse to install even simple systems, e.g. desalting and/or chrome recovery.

For new installed tanneries (or for those which renew a part of their facilities), it is to recommend to change the beamhouse processes from the present paddle procedure to drums. This measure will help to reduce the water consumption, and quality loss is not to expect.

3.II.: Pickle - free chrome tannage

The trials at CLRI have shown that this procedure can be applied for skins without decreasing the quality of the wet blues, but improving the quality of the remaining float. Although fine tuning for the tanning of skins is necessary. Beside a reduction of salt loadings also a better chrome exhaustion (and, v.v. less offer of common chrome tannin) can be achieved, and so the process will become feasible.

Last years trials have indicated that for unsplitted hides this procedure do not work sufficiently. Following the expert's experience, for lime splitted hides the pickle - free tannage can be applied without problems, and therefore it is to recommend to CLRI to carry out trials in this respect.

3.I.: Suggested follow - up projects

It is to expect that - due to the present pressure of the authorities - the implementation of cleaner technologies will become an all - over - Indian - concern. According to Dr. Raghavan, for tannery clusters (Bangalore - joint chrome recovery, Kampur - computerized chemical addition) such facilities are projected.

Every CETP depends on the quality of the received effluents. In order to enforce a sufficient primary treatment of all tanneries, connect with the CETP, a system of contribution of the tanners should be developed that takes not only the quantity of discharged effluents into account, but also considers the loading of the liquors. This systems reward those tanners, performing a sufficient primary treatment, while others with inadequate pretreatment should have to pay more.

During the expert's mission, many tanners expressed their apprehension of shortages on dumping sites. In order to reduce the quantity of tannery wastes, utilization methods for tannery by - products should be developed. Special attention should be drawn on

- fleshings
- glue stock, trimmings
- shavings from chrome and vegetable tanning
- hair sludge

While the utilization of fleshings (production of pet snacks), glue stock (separation into fat and protein) and shavings (production of leather boards and heel stiffeners) is state of the art in Europe and the USA, appropriate methods for the utilization of hair sludge are not available so far. In this respect, e.g., compost preparation in combination with other organic wastes could be one of the possibilities.

For tannery clusters, a centralized utilization of these by - products should be taken into consideration.

3.K.: Information for tanners

As suggested under several items, for already implemented cleaner technologies (chrome recovery, desalting, automated process), short leaflets should be published. Beside a short description of the procedure, its pro's and con's, the feasibility and references of international experiences should be given.