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ORGANISATION**

**REGIONAL PROGRAMME FOR POLLUTION CONTROL
IN THE TANNING INDUSTRY IN SOUTH EAST ASIA**

US/RAS/92/120-MODEL CETPs

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**EFFLUENT TREATMENT PLANT
MEERA HUSSAIN TANNERY, MELVSIHARAM, INDIA**

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LIST OF SYMBOLS & ABBREVIATIONS

BOD ₅	:	Biochemical oxygen demand, 5 days
BoD	:	Board of directors
CETP	:	Common effluent treatment plant
COD	:	Chemical oxygen demand
CO ₂	:	Carbon dioxide
cm	:	Centimetre
⁰ C	:	Degree celsius
DS	:	Dry solids
D	:	Day
dia/φ	:	Diameter
FB	:	Free board
F/M	:	Food to micro organism ratio
h	:	Hour(s)
HRT	:	Hydraulic retention time
HDPE	:	High density poly ethylene
INR	:	Indian Rupees
kg	:	Kilogram(s)
kW	:	Kilowatt(s)
l	:	Litre(s)
m ³	:	Cubic meter (1000 litres)
mg/l	:	Milligrams per litre
min	:	Minutes
MLSS	:	Mixed Liquor Suspended Solids
MLVSS	:	Mixed Liquor Volatile Suspended Solids
ND	:	Not detected
no.	:	Number
RPM	:	Revolutions per minute
pH	:	Negative logarithm of hydrogen ion concentration
SWD	:	Side water depth
SDB	:	Sludge drying beds
US \$:	US Dollar(s)
TNPCB	:	Tamil Nadu Pollution Control Board
t	:	Tonne (1000 kg)
W	:	Watt(s)

(Rate of exchange: 1 US \$ = INR 46.80)

1. INTRODUCTION

Meera Hussain Tannery is a small-scale rural tannery, about 60 years old, located at Nandiyalam, about 15 km East of Vellore, Tamil Nadu on the Chennai-Vellore highway. The tannery started as a purely vegetable tanning unit, processing buffalo hides from raw to semi-finished stage. In view of the seasonality of vegetable tanning, largely determined by the availability of raw material, the unit was lying idle for about six months a year, while for the rest of the year the tannery had been operating on job-work basis.

Under project US/IND/90/244 - Assistance in pollution control in the tanning industry in India, UNIDO gave technical assistance to the tannery to establish a low-cost effluent treatment plant (ETP) with a mini laboratory. The objective was to have a simple ETP that could serve as a model for similar isolated tanneries in rural areas.

On completion of the project, the ETP and laboratory were handed over to the tannery in 1995 and these have been operated and maintained by the tannery since then.

A wet blue tanning yard was added subsequently. It included three new wooden tanning drums and one mechanical fleshing machine. The wet-blue tanning activities were started in September 1997.

2. ETP – DESCRIPTION

The tannery processes 4-5 tonnes of raw hides to semi-finished leather and discharges around 50 m³ of effluent per day. The tannery has an ETP of 60 m³/d capacity. The treatment process flow diagram and layout are given in Dwg 1 and 2 in Annex 2.

The effluent generated from the various process sections is passed through 6 manually cleaned screens and pre-settling tanks. The effluent after pre-settling is admitted to an equalization tank provided with a floating aerator for mixing and homogenization. The equalized effluent enters raw effluent sump where liquid alum and lime slurry, prepared in two sintex tanks are dosed. The effluent mixed with chemicals is pumped into a hopper bottom settling tank where the sludge settles. Settler sludge is drawn off to the sludge drying beds.

Overflow of primary settling tanks is taken to an anaerobic tank provided with UV lamps for improved biological reaction through bio-solar reaction. The effluent being readily biodegradable in nature gets effectively treated by this treatment.

The effluent from the anaerobic tank is admitted to a degasification tank originally provided with one 2.2 kW ejector type aerator. Later, a floating aerator of the same capacity replaced the ejector, which is now kept as a standby.

Overflow of the degasification tank is discharged to 4 polishing ponds operated in series. The residual organics in the effluent is removed by photosynthetic action of algae and microorganisms in the polishing ponds. The overflow of the last polishing pond is discharged as treated effluent

2.1. Chrome effluent treatment

Originally, the tannery was carrying out only vegetable tanning and due to seasonal availability of raw material, the tannery could operate only for 3-4 months a year. Later, chrome tanning was started in 1997 to be able to operate the tannery for at least 5-7 months a year. A simple system for treatment of chrome is established as follows:

Spent liquor from chrome tanning is segregated and sent to a collection tank of 500-litre capacity. This is pumped to a reaction-cum-settling tank where MgO [supplied free of cost by a company called Chemways] is added in slurry form. There is no pH control and there is no mechanical agitation in the reaction tank. After settling, the supernatant is sent to the solar evaporation pond. Chrome sludge is taken to a collection tank from where Chemways collects it free of cost regularly, for recovery of chrome at their works.

3. ETP – PERFORMANCE

Performance of the ETP was generally satisfactory when all the equipment were operated and maintained well. The ETP had achieved BOD values as low as 20 mg/l in the treated effluent. However, certain parameters like COD and total dissolved solids remain on the higher side. The COD values were found fluctuating from 250 to 600 mg/l and TDS from 14,000 to 17,000 mg/l.

4. ENVIRONMENTAL LABORATORY & MONITORING

4.1. Laboratory instruments

The laboratory is provided with the following instruments.

#	Equipment	Nos.
1.	Portable pH meter	1
2.	Precision balance monopan [capable of weighing up to 1/10 mg]	1
3.	COD distillation apparatus with 500 ml flasks with ground glass necks	1 set
4.	55 litre oven for operation at 100 to 105 C	1
5.	Pocket conductivity meter	1
6.	Hot air oven	1
7.	Water bath	1
8.	Electric bunsens	2

4.2. Glass wares

The laboratory is provided with all basic glassware items including:

#	Equipment
1.	Separatory funnels
2.	Dessicator
3.	Measuring cylinders of different milliliter capacity
4.	Beakers

5.	Graduated and ungraduated pipettes, burette with stand and porcelain tile
6.	Volumetric standard flasks
7.	Conical flasks
8.	Funnel
9.	Reagent bottles
10.	Wash bottles
11.	Evaporating dishes
12.	Test tubes
13.	Watch glass
14.	Glass rods

4.3. Chemists

Currently there are two graduate [B.Sc. Chemistry] chemists working in the laboratory. Both of them were given one week training in CETP-Ranitec, Ranipet, a model CETP of UNIDO.

5. ETP COMPONENTS AND SPECIFICATIONS

The sizes and specifications of different units in the ETP are given below:

Pre-settling tanks	Brick masonry tank 2.5 m x 3.0 m x 3.0 m SWD
Equalisation tank	RCC tank 6 m x 6 m x 3 m SWD
Aerator in equalization tank	High speed floating type, 2.2 kW, Enkem make
Raw effluent pumps	2 Nos, centrifugal, self priming, Stork make 1.5 kW
Settling tank	FRP tank, 2.5 m dia x 1.5 m SWD
Anaerobic lagoon	RCC tank, 230 m ² x 3.0 m SWD
Lamps in anaerobic lagoon	12 nos. 500W capacity, Halogen lamps
Degassifier	Circular RCC tank 6.0 m x 2.0 m SWD
Aerator in degassifier	High speed floating aerator, 2.2 kW, ACS make
Polishing pond [4 nos.]	Brick masonry tanks, 19 x 19 x 0.8 m SWD
Sludge drying beds [4 nos.]	Brick masonry beds with gravel media, 10 m x 10 m x 0.8 m TD, total area 400 m ²

6. OPERATIONAL PARAMETERS

Operational parameter	Factors maintained at present
Chemical dosage	100-200 ppm of alum and 0-100 ppm of lime
Nutrients	No nutrients are added at present
Dissolved oxygen	DO level in degassifier is 2.0 mg/l
Screenings removal and sludge withdrawal timings	The screenings are removed once a day. Sludge from primary settling tank is withdrawn once every day.
Sludge treatment	
Solids consistency	3-4% at primary settling tank underflow.
Time taken for sludge drying in sludge drying beds	10-15 days

Approximate characteristics of dewatered sludge	Moisture: 68% [humid sludge], calcium: 4-7% metal hydroxides: 1 – 2% chromium: 0.2 – 0.8%, silt, sand, etc. 3 – 6%, organic matter: balance (all dry weight)
Maintenance	
Oiling & greasing cycle	No specific frequency, done alongwith the oiling and greasing of motors in the tannery
Frequency of painting of structures	Once in a year
ETP operation monitoring	
Log sheets maintained in the ETP	Lab registers, chemical dosages and stock

7. EFFLUENT CHARACTERISTICS BEFORE AND AFTER TREATMENT

[Average for the period from September '98 to January 2000]

#	Parameter	Unit	Raw effluent	Final treated effluent	TNPCB norms*
1.	pH		8.7	7.9	5.5 – 9.0
2.	Suspended solids	mg/l	5,360	185	100
3.	Total dissolved Solids	mg/l	15,800	15,250	2,100
4.	BOD	mg/l	2,855	55	30
5.	COD	mg/l	5,390	520	250
6.	Sulphides	mg/l	165	7.2	2
7.	Total chromium	mg/l	85	6.2	2

**for discharge to inland surface water*

8. COST OF TREATMENT

[Average for the period from September '98 to January 2000]

#	Cost component	Cost in Indian Rupees	Cost in US\$
1.	Power	10,550	225
2.	Chemical	6,430	137
3.	Salary & labour	16,200	346
4.	Repairs & maintenance	4,800	103
5.	Laboratory analysis	7,450	159
6.	Sludge dewatering & handling	2,650	57
7.	Miscellaneous	2,000	43
8.	Depreciation on investment	14,020	300
	Total	64,100	1,370

Treatment cost per cubic meter of effluent: INR 32.9 [US \$ 0.70]

Treatment cost per kg BOD₅ removed: INR 11.7 [US \$ 0.25]

Treatment cost per kg COD removed: INR 6.75 [US \$ 0.14]

Note: Data after January 2000 has not been collected after the tannery was taken over by a foreign company.

9. IMPROVEMENTS MADE

To improve the performance of the ETP in MHT, a study was conducted by UNIDO and a report on upgradation made in April 1998.

Following measures were recommended:

- Frequent desludging of pre-settling tanks
- Frequent cleaning of screens in raw effluent channel
- Improved maintenance of records
- Proper segregation of chrome liquor
- Additional one stork pump of 1.5 kW capacity
- Installation of missing lamps [approximately of 12 numbers]
- Providing a floating aerator of 2.2 kW as spare for equalization & degasification tanks
- Providing epoxy coating in chrome collection and reaction tanks

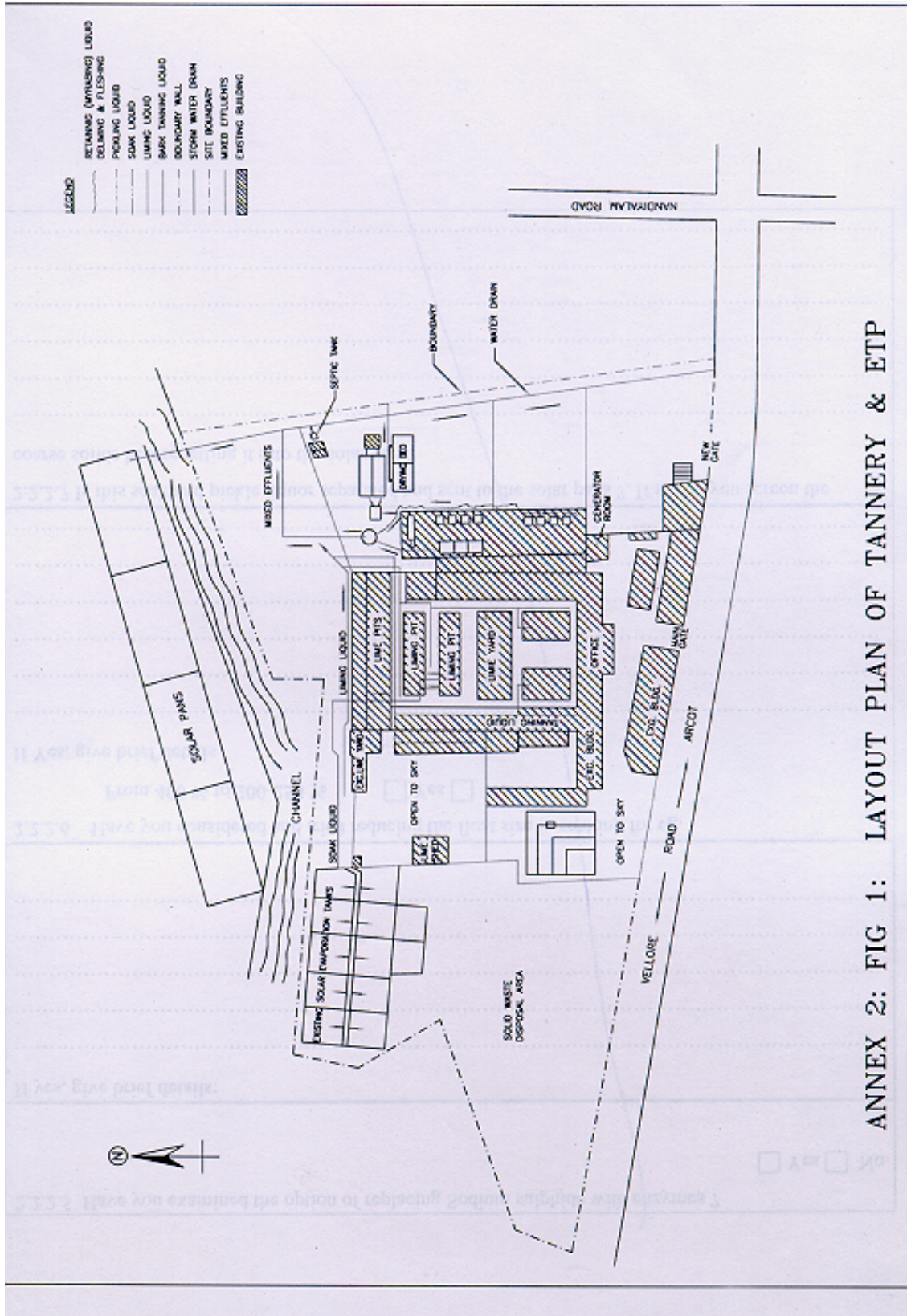
All the above measures have been implemented with the assistance of UNIDO.

10. UNIDO's ASSESSMENT

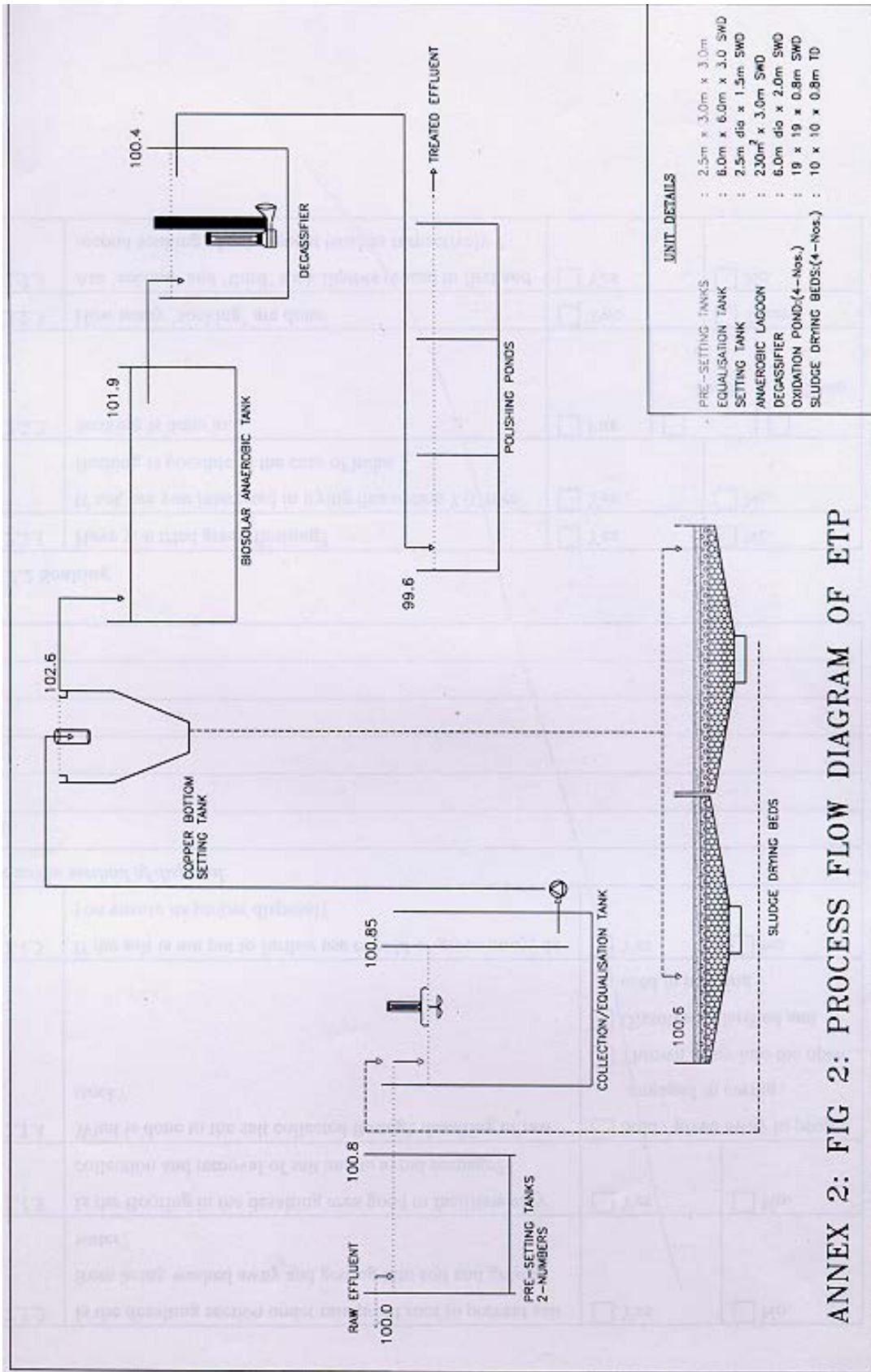
The performance of the ETP was quite satisfactory when the tannery operated regularly. But the tannery came to be plagued by inadequate and infrequent work orders. Even after the chrome tanning was started, the situation did not improve. The tannery was taken over by Victor Smorgan & Co. Ltd. a foreign company in February 1999. Of late it has been learnt that this arrangement too has not sustained. The ETP performed quite well when the tannery operated regularly. But, of late, for entirely non-technical reasons, the tannery works by fits and starts and therefore the ETP too is operated only from time to time.

Annex - 1
List & Addresses of suppliers of equipment

Item	Supplier	Local service person/agent
ETP turnkey contractor/supplier of all systems	Enkem Engineers P. Ltd. 824, Poonamalle High Road Chennai 600 010 Ph. 6411362/6428992 Fax: 6411788	Enkem Engineers P. Ltd. 824, Poonamallee High Road Chennai 600 010 Ph. 6411362/6428992 Fax: 6411788
Ejector aerator (now used as a standby in degasification tank)	Kishor Pumps P. Ltd. A-13/H,MIDC,Pimpri Pune 411 018	Beam Engineers 102, Mogappair Chennai 600 050
Centrifugal pumps	Stork Pumps 3, Anthu Street, Santhome Chennai 600 004	Fabriken Agencies P. Ltd. 11, 7 th Cross Street Shastri Nagar, Adyar Chennai 600 020
Floating aerator	Aqua Chemicals & Systems Mfg. Ltd. 42, First Street Kamaraj Avenue, Adyar Chennai 600 020 Ph:4420550	Aqua Chemicals & Systems Mfg. Ltd. 42, First Street Kamaraj Avenue, Adyar Chennai 600 020 Ph:4420550



ANNEX 2: FIG 1: LAYOUT PLAN OF TANNERY & ETP



ANNEX 2: FIG 2: PROCESS FLOW DIAGRAM OF ETP