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ASSISTANCE IN TREATMENT OF TANNERY EFFLUENT IN THE STATE OF TAMIL NADU, INDIA (PHASE II)
US/IND/97/124

TERTIARY TREATMENT AND REHABILITATION OF THE COMMON EFFLUENT TREATMENT PLANT (CETP) AT AMBUR TANNERY EFFLUENT TREATMENT CO. LTD. (AMBURTEC), AMBUR, THUTHIPET

FINAL REPORT

Prepared by TEH-PROJEKT HIDRO, Rijeka, Croatia
Contract 98/189

Project Manager
J. Buljan, Agro-industries Branch

UNIDO
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
VIENNA - AUSTRIA

EXPLANATORY NOTES

BOD_5	5 days Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
TSS; SS	Total Suspended Solids; Suspended Solids
TDS	Total Dissolved Solids
MLSS	Mixed Liquor Suspended Solids
MLVSS	Mixed Liquor Volatile Suspended Solids
SVI	Sludge Volume Index (Mohlman Index)
D.O.	Dissolved Oxygen
CETP	Common Effluent Treatment Plant
RePO	UNIDO Regional Programme Office, Chennai
AMBURTEC	Ambur Tannery Effluent Treatment Co, Ltd.
TOR	Term of Reference
TEH-team	TEH-PROJEKT HIDRO, Rijeka, Croatia Team (Contractor)
O & M	Operation & Maintenance
Rs	Indian Rupees (US$ 1.00 = approx. Rs 43 - 44, June 2000)

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1. INTRODUCTION

TEH-PROJEKT HIDRO d.o.o. Rijeka, Croatia signed the contract with UNIDO Vienna No. 98/189, dated 08.10.1998, based on UNIDO Request for Proposal No. P. 98/123, dated 13.07.1998 and Term of Reference, dated 17.06.1998 and TEH-PROJEKT's proposal dated 10.08.1998.

The contract and Term of Reference cover a significant part of activities under the project US/IND/97/124: Assistance in treatment of tannery effluent in the state of Tamil Nadu, India (Phase II) - Tertiary treatment, utilisation and disposal of sludge.

The specific component of the project was entitled The tertiary treatment and rehabilitation of the common effluent treatment plant (CETP) at the Ambur Tannery Effluent Treatment Co. Ltd. (AMBURTEC), Ambur, Thuthipet, Tamil Nadu, India.

The main subcontractor's tasks were:

- Collect and consolidate all available documents and information on the Amburtec CETP, Ambur, Thuthipet
- Critically review and identify deficiencies in design, construction, equipment and operation of the CETP
- Suggest interventions, including specifications of civil works and equipment, required to rehabilitate and upgrade the CETP and thus enabling it to meet the prescribed discharge standards
- Conduct technical review of the locally prepared design for setting up a pilot irrigation system using treated effluent
- Assist Amburtec and UNIDO in selecting the most suitable bidder for supply of equipment
- Assist Amburtec and UNIDO in commissioning of the purchased equipment and start-up of the rehabilitated CETP

It was envisaged that the services listed would be provided in the course of three field missions resulting in four reports: three reports following the field missions plus the Draft/Final report.

TEH-PROJEKT HIDRO d.o.o. Rijeka has completed all activities and provided the inputs according to the TOR and Contract 98/189 and has submitted three Field Mission Reports and the Draft Final Report .

This report summarizes all these activities albeit without repeating the contents of earlier reports some of were already used and can remain as handy, stand-alone documents. It also takes into account remarks and suggestions made by UNIDO concerning the Draft Final Report.

2. ACTIVITIES

The TEH's team carried out the following activities:

- During the first field mission the team visited the UNIDO RePO Chennai and the Amburtec CETP, Ambur for collection of supplement documentation and information, agreement on the co-ordination of the activities, for the in site inspection of the in-house pre-treatment of raw effluent, effluent collection system and effluent treatment process, civil work structures and equipment and discussions with the Amburtec CETP authorities.

- Prepared the document: Assistance in the treatment of tannery effluent in the State of Tamil Nadu, India (Phase II); US/IND/97/124, Tertiary treatment and rehabilitation of the common effluent treatment plant (CETP) at Ambur Tannery Effluent Treatment Co. Ltd. (AMBURTEC), Ambur, Thuthipet: **Book 1: First Mission Report – General Information, December 1998.**

- Prepared the document: Assistance in the treatment of tannery effluent in the state of Tamil Nadu, India (Phase II); US/IND/97/124, Tertiary treatment and rehabilitation of the common effluent treatment plant (CETP) at Ambur Tannery Effluent Treatment Co. Ltd. (AMBURTEC), Ambur, Thuthipet: **Book 2: Techno-economic Study and Design of the Rehabilitation of the CETP Thuthipet, December 1998.**

- Reviewed the report "Rehabilitation & utilisation of degraded land at RANITEC and AMBURTEC CETPs, prepared by Mr. Jayaraman, March 1999" and prepared the paper: Assistance in the treatment of tannery effluent in the state of Tamil Nadu, India (Phase II); US/IND/97/124, Tertiary treatment and rehabilitation of the common effluent treatment plant (CETP) at Ambur Tannery Effluent Treatment Co. Ltd. (AMBURTEC), Ambur, Thuthipet: **Technical review of the report "Rehabilitation & utilisation of degraded land at RANITEC and AMBURTEC CETPs**, prepared by M. Jayaraman, March - April 1999.

- Evaluated quotations of equipment required for the CETP rehabilitation

- During the second mission visited UNIDO Vienna for the final technical evaluation of quotations

- Prepared the document: Assistance in the treatment of tannery effluent in the state of Tamil Nadu, India (Phase II); US/IND/97/124, Tertiary treatment and rehabilitation of the common effluent treatment plant (CETP) at Ambur Tannery Effluent Treatment Co. Ltd. (AMBURTEC), Ambur, Thuthipet: **Second Report – Evaluation of the Offers, October 1999.**

- During the third field mission visited the UNIDO RePO Chennai and Amburtec CETP, Ambur, Thuthipet and scrutinized the quality of equipment supplied and installed as well as overall on-going activities CETP upgrading activities. **The TEH-PROJEKT assisted in the start-up, commissioning and fine tuning of the newly requisitioned equipment and the whole CETP and instructed the CETP staff in the further operation.**

- Prepared the document: Assistance in the treatment of tannery effluent in the State of Tamil Nadu, India (Phase II); US/IND/97/124, Tertiary treatment and rehabilitation of the common effluent treatment plant (CETP) at Ambur Tannery Effluent Treatment Co. Ltd. (AMBURTEC), Ambur, Thuthipet: **Third Field Mission Report, June 2000.**

3. FINDINGS

3.1. The main findings of the first field mission

The existing CETP can not produce the treated effluent conform to existing discharge standards due to the problems existing in the CETP functioning (by design errors, construction, equipment selection and quality, management, maintenance etc.)

The CETP is now working in the secondary treatment practically as the aerated lagoons and not as activated sludge process as was designed (the concentration of the MLSS is very low).

The actual final result - analyses of the treated effluent, although did not meet the actual discharge standards, are not too bad. The BOD was approx. 100 - 150 (sometime less than 100), COD 650 - 800, SS 100 - 150 or the removal efficiency for these parameters were approx.: 85 - 90 % for BOD, 70 - 80 % for COD and 95 - 98 % for SS.

The operating of the existing CETP can and should be improved without waiting for the CETP upgradation. The successful attempts were made more time in the past to improve the operating of the CETP what indicate that the improvement at the existing CETP is possible. It is not clear why these improvements were not sustained. It was estimated that it is necessary to aid the CETP management in the improving of the CETP operation and maintenance.

Many experts inspections were organised to the CETP, many reports and studies were prepared as the attempts to upgrade the existing CETP. Practically all previous document contain the similar conclusions on the CETP problems, but the suggestion to solve these problems were different. Some of the authors suggested the maximal possible use of existing facilities, but some suggested the construction of important new civil work structures and facilities.

One of the important problem for the CETP study, especially for the engineering problems and for the upgradation of the CETP is the lack of accurate "as-built" documentation.

The upgradation of the CETP is really necessary, because some of the equipment is in the very bad condition and provisional solution can not be also the final solution. The most urgent problem are the aeration systems in the aeration tanks and oxidation ditches, secondary settling and change of some destroyed equipment. The activities of second priority are the upgradation of some treatment steps for achieving the better operation results and/or easier operation, and the replacement of some other equipment, now in the bad conditions.

The following baseline data were specified:

	Minimum	Maximum	Average
Waste water flow m^3/d	1500	2200	1800
pH	6	9	7.5
BOD_5 @ 20 °C mg/l	1000	1600	1400
COD mg/l	2000	4000	3000
Total Suspended Solids (TSS) mg/l	3000	5000	4000
Sulphides mg/l	50	100	80
Chlorides mg/l	5000	7000	6000
Total Dissolved Solids (TDS) mg/l	10000	14000	12000
Chrome mg/l	40	100	60
Sulphates mg/l	900	2000	1500

The following expected treated effluent characteristics as per Tamil Nadu Pollution Control Board were specified:

pH	6 - 9
BOD_5 @ 20 °C mg/l	< 30
COD mg/l	< 250
Total Suspended Solids (TSS) mg/l	< 100
Sulphides mg/l	< 2
Chlorides mg/l	< 1000
Total Dissolved Solids (TDS) mg/l	< 2100
Chrome mg/l	< 2
Sulphates mg/l	< 1000

I was agreed that it is not possible to reduce the TDS and chlorides with conventional physical-chemical and biological treatment and non-availability of immediate viable solution.

TEH-PROJEKT, as UNIDO subcontractor, will suggest the designs of the upgradation of the CETP in phases and in some alternatives. The existing facilities will be retained as much as possible. The choice of the domestic (cheaper and less accurate) and imported (more expensive but also more accurate and reputed) equipment will be possible.

3.2. The main suggestions for the rehabilitation of the CETP AMBURTEC, Thuthipet, Ambur

Many attempts were made to try to improve its efficiency and various modifications were suggested but they were either not accepted or not consequently and fully implemented.

According the contract and Terms of Reference (TOR), Teh-projekt's task was to make a comprehensive techno-economic study with in-depth assessment of the CETP and of suggestions made earlier and recommendations on the actions to be taken to rehabilitate and upgrade the CETP to be able to meet the discharge standards for main parameters.

TEH-PROJEKT visited Amburtec for the in depth CETP assessment and reviewed all documents and studies available. Its team had a very useful exchange of views with CETP management local specialists and RePO staff.

Book 1 contains the general information about the TEH-PROJEKT HIDRO field mission and background information about the CETP.

This Book, Book 2 contains the actual techno-economic study with design, specification of equipment and civil works including estimates of investment and operation cost. Its main conclusions and recommendations can be summarized as follows:

- Aeration in the activated sludge aeration tanks i.e. in the oxidation ditches and in the (previously anaerobic) contact filters converted into the tanks for aerobic biological activated sludge treatment is insufficient because the originally installed brush aerators had been run down and the subsequently installed small aspirating and submersible aerators are an inadequate solution.

- Due to faulty equipment, insufficient capacity of secondary settling tank and other operational and management problems, it is quite difficult to maintain or even to increase the necessary level of MLSS concentration. The result is that in effect the originally designed activated sludge treatment process has been turned into less efficient aerated lagoons treatment.

- There is evident lack of adequate monitoring facilities and practical experience required to operate such a CETP.

Teh-projekt proposes the rehabilitation and upgradation of the CETP in phases. During Phase I the first priority modifications are to be made; implementation of measures envisaged for Phase II will be linked to actual effects of the efficiency improvements achieved during Phase I as well as to progress in improving the construction and operation of in-house pre-treatment in individual tanneries and upgrading the day-to-day Amburtec CETP monitoring and management.

Specific actions to be taken during Phase I:

- **Installation of reliable submersible pumps for raw effluent**

  The original vertical shaft pumps are out of order, and the installed self-priming STORK pump's characteristics are inadequate.

- **Reconstruction of the existing equalisation tank (elimination of the submersed walls) and installation of the adequate mixers/aerators.**

  It is not necessary to increase the volume of the tank, because the retention time for the average effluent volume is approx. 23 hours.

- **Installation of the appropriate and reliable aeration systems in the aeration tanks (oxidation ditches) including the necessary tanks reconstructions.**

  Three (3) alternatives have been considered: brush aerators, fixed surface aerators and ejector aerators.
  From the technical point of view brush aerators are the preferred alternative. However, this type of aerators is not available in India and they have to be imported and the price of such aerators is relatively high.

- **Construction of the new secondary settling tank**

The existing secondary settling tank has not the necessary surface/capacity to ensure the required concentration of SS in the treated effluent and to recycle the necessary amount of the MLSS back to the biological activated sludge treatment.

Recommendations for Phase II:

- Installation of the coarse screens at the effluent inlet
- Installation of the coarse pre-settler
- Installation of the fine automatic screen
- Construction of new sludge drying beds

The necessity of implementation of above measures will directly depend on results of the in-house pre-treatments in individual tanneries.

- Installation of the new flocculator mixer and sludge scraper in the primary clariflocculator.

The existing calriflocculator is without flocculator mixer and the scraper mechanisms is very corroded.

- Activation of some of 24 tanks (previous anaerobic contact filters) as the first step of biological aerobic activated sludge treatment, by reconstruction of the pipeline systems for the primary treated effluent and recycled sludge.

This step should taken only in case the biological treatment in the oxidation ditches will

be insufficient (especially during peak periods). The existing aspirating and submersible aerators from the oxidation diches (where the new aerator will be installed) will be used for their aeration

- **Installation of measuring channel at the effluent outlet in order to have the possibility for on-line control of the final treated effluent.**

- **Reconstruction of the secondary sludge pumping system (pumps and pipeline).**

  The final decision will depend on the outcome of verification of the actual situation as it is not sure whether the data available about this system are correct.

- **Reconstruction of the chemical preparation and dosing systems to have the possibility for easier controlled and better chemical treatment.**

  This system is now under reconstruction but detailed data were not available and were not discussed during the field mission.

- **Upgradation of the electrical installations**

  Depending on the accepted alternative for the reconstruction, the existing capacity of the electrical installation may be inadequate.

- **Upgradation of the on-line instrumentation and introduction of automatic control in order to better monitor and control the treatement process.**

- **Setting up of the tertiary treatment**

  The necessity to set it up will depend on the quality of treated effluent produced by the rehabilitated and upgraded CETP.

The estimations of costs for the suggested upgradation are presented in the following tables:

ALTERNATIVE 1.: Raw effluent pumps as necessary for the installation of the pre-settler and aeration system in oxidation ditches with brush aerators.

ALTERNATIVE 2.: Raw effluent pumps as necessary for the installation of the pre-settler and aeration system in oxidation ditches with fixed surface aerators.

ALTERNATIVE 3.: Raw effluent pumps as necessary for the installation of the pre-settler and aeration system in oxidation ditches with ejector aerators and submersible mixer.

Phase I (First priority)

Process code	Item	Local equipment	Imported reputed equipment
		Total price US$	Total price US$
	CIVIL WORKS - ALTERNATIVE 1.:	47000	47000
	CIVIL WORKS - ALTERNATIVE 2.:	49000	49000
	CIVIL WORKS - ALTERNATIVE 3.:	33000	33000
	EQUIPMENT - ALTERNATIVE 1.:	323000	390000
	EQUIPMENT - ALTERNATIVE 2.:	123000	310000
	EQUIPMENT - ALTERNATIVE 3.:	203000	414000
	TOTAL - ALTERNATIVE 1.:	370000	437000
	TOTAL - ALTERNATIVE 2.:	172000	359000
	TOTAL - ALTERNATIVE 3.:	236000	447000

Phase II:

Full rehabilitation (Phase I & Phase II):

Process code	Item	Local equipment	Imported reputed equipment
		Total price US$	Total price US$
	CIVIL WORKS - ALTERNATIVE 1.:	70000	70000
	CIVIL WORKS - ALTERNATIVE 2.:	72000	72000
	CIVIL WORKS - ALTERNATIVE 3.:	56000	56000
	EQUIPMENT - ALTERNATIVE 1.:	474000	567000

	EQUIPMENT - ALTERNATIVE 2.:	274000	487000
	EQUIPMENT - ALTERNATIVE 3.:	354000	591000
	TOTAL - ALTERNATIVE 1.:	544000	637000
	TOTAL - ALTERNATIVE 2.:	346000	559000
	TOTAL - ALTERNATIVE 3.:	410000	647000

Operation costs estimates for materials and electrical energy for the alternative 1. and 2:

	Item	US$/year	% of total
1	**MATERIALS**	**124750**	**44.6**
3	**ENERGY**	**155000**	**55.4**
	TOTAL OPERATIONAL COSTS	**279750**	**100.0**

Total operational costs for 1 m^3 of treated effluent:

$$\frac{279750}{1800 \times 365} = \text{US\$ } 0.43/m^3$$

The lists of potential equipment suppliers are also given.

3.3. The main findings of the review of the report "Rehabilitation & utilisation of degraded land at RANITEC and AMBURTEC CETPs

Based on the inspection of the available documentation, inspection of the site at Ambur and the meetings held during the first filed mission the conclusions and recommendations were as follows:

- The task of TEH-PROJEKT HIDRO d.o.o. Rijeka, per TOR, was to review only the technical solution for the construction of the hydraulic systems for the irrigation of degraded land at Ambur. In the concerning Report, technical solution for the irrigation is not presented Without correct specification of the effluent consumption, correct

suggestion for the technical solution for the irrigation and the correct calculation of the irrigation system, it is not possible to comment neither the principle, nor the calculation, technical solution, equipment specification and operational costs of the irrigation system.

- Nevertheless, TEH-PROJEKT HIDRO d.o.o. Rijeka reviewed also other aspects of the presented Report. The main remark is the wrong statement that the (conventional) effluent treatment can reduce the TDS, sodium and chloride for approx. 50 %. In reality no reduction of these components is during the (conventional) effluent treatment.

- Many useful data concerning the quality of the agriculture land and underground water in the neighbourhood of CETP Ambur were presented. These values confirm the very high pollution.

- Using the (treated) tannery effluent for irrigation, the situation on the land and underground water can not be better than now, but worse.

- Suggestion to install the drainage system will not solve the problem of the (treated) effluent disposal, because no solution for the drained water disposal is suggested. If the drainage is really necessary, the problem of the effluent, loaded with high TDS, is turned back to the beginning (what to do and where dispose the effluent (or now drained water) with high TDS?).

- Nevertheless TEH-PROJEKT HIDRO d.o.o. support the suggested cropping programme to collect the supplement information and to try to find the economic use of the (treated) effluent for the commercial agriculture production. Because the process of the degradation of the land and underground water is relatively slow, to have an accurate conclusion, it will be necessary to do the tests for the relatively long (not easy to determine) time.

3.4. The outcome of the technical evaluation of equipment quotations

Based on all activities and correspondence concerning the tendering of the equipment and services for the rehabilitation of Amburtec CETP it was possible to give the following conclusions and recommendations:

1. The TEH documentation for the rehabilitation of Amburtec CETP was accepted and was used as the base for the next activities.

2. The TEH documentation and the proposition of RePO were presented to Amburtec and agreed.

3. Although the TEH suggestion to rehabilitate oxidation ditches (as the most important point) at Amburtec CETP with brush aerators of reputed producer was accepted as the best solution, due to very high price of the imported brush aerators (the experienced manufacturer does not exist in India), this solution could not be realised and it was accepted to tender the fixed surface aerators, expecting that the Indian producer will be able to supply such aerators with the accompanied technical documentation for the installation of such aerators in the existing oxidation ditches (including the modification of the ditches if necessary).

4. As agreed, UNIDO tendered the equipment for the aeration of the oxidation ditches (fixed surface aerators) and the service for the commissioning and stabilisation of the aeration system and the whole CETP for 6 months.

5. In the first bidding, three (3) local Indian offers were collected and one (1) imported (France). Any of the received Indian offers were not conform to the specification in PR, due to the lack of the experience of Indian companies producing the fixed surface aerators of acceptable quality, in its application in the oxidation ditches. The French company did not understood the PR and the specification and has offered the brush aerators. Due to this, very high (unacceptable) price and because the additional asked services were not offered this offer was rejected.

6. Al three (3) local Indian companies offered installation of their aerators in the oxidation ditches which should be converted into the conventional aeration tanks for the activated sludge biological treatment. One company offered unacceptable floating aerators, and two companies offered fixed surface aerators, one without the suggestion to eliminate the partition wall and other with the suggestion to eliminate the partition wall.

7. Due to the impossibility to rehabilitate the oxidation ditches as desired (neither with imported brush aerators (to high price), nor with fixed surface aerators (to high price for the imported aerators of experienced companies, and lack of the practical experience in the application of this type of the aerators in the oxidation ditches at local companies, able to produce the aerators of acceptable quality for the acceptable price), UNIDO, RePO and Amburtec withdrew after first bidding the demand to rehabilitate the oxidation ditches (as the oxidation ditches) and accepted the conversion of the oxidation ditches into the conventional aeration tanks for the activated sludge biological treatment.

8. Enkem was suggested after first bidding as the reputed producer of the fixed surface aerators and as the company with which UNIDO has a satisfying experience. Because the price for the aerators for the aeration tanks (modified oxidation ditches), calculated as the only biological treatment step, was too high, Enkem suggested to continue to use the existing pre-aeration tanks (1. step of biological treatment) with existing aspirating and submersible aerators, and to install smaller aeration system in the modified oxidation ditches. This Enkem's offer, including the guarantee for the functioning of the

aeration system and the whole CETP and the quality of the treated effluent, including also the asked services was accepted by RePO and Amburtec.

9. Apparently for some procedural reasons, beyond our control, UNIDO has repeated the bidding procedure, and the new offers were collected. Four (4) offers were collected in the specified term and the fifth with considerable delay.

10. Although one of the bids (SWARAJ) virtually coincides with the original TEH proposal (brush aerators), it was reportedly declined by the CETP management. This offer was not the lowest in the price.

11. Accepting in view the above, TEH endorses the RePO's suggested to accept the BIOTIM POLUTECH offer for the following reasons:

- BIOTIM POLUTECH is the bidder which is ready to guarantee the operation of the existing oxidation ditches with fixed surface aerators, really as genuine oxidation ditches.

- The offer contains all components requested: equipment supply, electrical works, transportation, erection, trial run & stabilization for 3 months (commissioning), operation of CETP for 3 months, spares for 2 years trouble free operation.

- BIOTIM POLUTECH accepted to give the guarantee and confirm it during 1 month of the operation after stabilization of the CETP, for the treated effluent quality as asked in UNIDO specification, except for TDS and chlorides.

- They guarantee achieving all parameters.

- The offer is absolutely the lowest in price.

- They accept UNIDO's Terms of payment (35 % against supply of all materials, 10 % against completion and satisfactory trial run, 30 % against satisfactory commissioning and stabilization, 25 % against satisfactory operation), although they offered their own terms of payment and the reduction in total price of RS. 100.000, if this terms will be accepted. Due to very sensitive question of the technical guarantee the RePO's suggestion to contract UNIDO's Terms of Payment should be accepted.

As the final conclusion the order can be placed to BIOTIM POLUTECH according their offer: TECHNICAL BID ref. BPL/050/99, dated 20.08.1999 and PRICE BID ref. BPL/050-A/99, dated 20.08.1999 and letter ref. BPL/050/99, dated 20.09.1999., and RePO's evaluation (TEXT FOR ROUTING SLIP).

12. Amburtec tendered also the mechanical equipment other than aeration system, as suggested by TEH and RePO (submersible raw effluent pumps, floating surface aerators in the equalisation tank, modification of the clariflocculation mechanism in the primary settling tank, scraper and accessories for the new secondary settling tank).

13. Three (3) offers were collected for submersible raw effluent pumps. All three (3) offers were technically acceptable (after clearance of some questions) and the choice of the Fluidline (KSB) offer with the lowest price was suggested.

14. Four (4) offers were collected for floating surface aerators. All four (4) were technically acceptable (after clearance of some questions) and the choice of the Enviro science offer with the lowest price was suggested.

15. Two (2) offers were collected for the modification of the clariflocculation mechanism. One offer was only for the scraper (without flocculation mechanism) and was rejected. Other from Biotim Polutech was not clear and supplement information were asked. Biotim declared orally that he offered the reconstruction of clariflocculation mechanism (including the flocculation mechanism), but did not presented the design of the modification. The choice of the Biotim Polutech offer was suggested, but after the official presentation and acceptance of the modification design.

16. Three (3) offers and one (1) proposition were collected for the scraper and accessories for the new secondary settling tank. All three (3) offers were technically acceptable (after clearance of some questions) and the choice of the Biotim Polutech offer with the lowest price was suggested. The proposition for the use of reactors suggested for tertiary treatment by Mr. Sundaramoorthy, as the secondary settling tanks is not acceptable. The construction of the settling tank can start after the acceptance of the basic design of the settling tank supplied by producer of the equipment and the preparation of the constructive design and clearance of all connected questions (feeding, sludge discharge, etc.).

3.5. The main findings of the third field mission

Based on the inspection of the CETP Amburtec, participation in the start-up of the rehabilitated first two oxidation ditches and the meetings held during the third field mission, the conclusions and recommendations were as follows:

1. Some of the planned activities at CETP Ambur for the 1. phase of the CETP's rehabilitation are finished (installation of three new aerators in the equalisation tank, reconstruction of the clariflocculator, rehabilitation of first two oxidation ditches (No. 3 & 4)), and some activities (civil works structures the equipment) are under construction and installation (purchase and installation of the new two raw effluent submersible pumps in the receiving sump, repair of two existing aerators for the equalisation tank, rehabilitation of the next two oxidation ditches (no. 1 & 2), construction of the new secondary settling tank with secondary sludge recycling system)

2. The checking of the first two rehabilitated oxidation ditches with plain water was successful.

3. The first two rehabilitated oxidation ditches were started-up as follows:

   - the ditches were filled-up with the plain water
   - both aerators in each ditches were operated
   - the ditches were seeded with the activates sludge from some other CETPs
   - the ditches were fed with approx. 10 % of the full actual flow (approx. 100 m^3/d)
   - the feeding flow (as it was actually fed by previous anaerobic step) was increased, according the increasing of the activated sludge concentration (settleable solids, MLSS)
   - D.O. concentration was regularly measured, to confirm the presence of the correct amount of D.O.
   - the COD concentration at inlet to the ditches and outlet from the secondary settling tank were checked
   - finally the full actual flow was fed to the rehabilitated oxidation ditches (approx. 1000 m^3/d) and the previous anaerobic step was by-passed
   - the situation at the end of this phase of the start-up was as follows:
     * flow: approx. 1000 m^3/d
     * Settleable solids: ditch No. 3: 120 ml/l, No. 4: 140 ml/l
     * Settleable solids in the recycled secondary sludge: 200 - 400 mg/l (sometime (after previous shut-of of the pumps, for some longer time) approx. 900 mg/l)
     * MLSS: ditch No 3: 1814 mg/l, No. 4: 2182 ml/l
     * SVI: ditch No. 3: 66 ml/g, No. 4: 64 ml/g

* COD: equalisation tank: 1610 mg O_2/l, primary treated effluent: 1150 mg O_2/l, oxidation ditch No. 3: 243 mg O_2/l, oxidation ditch No. 4: 238 mg O_2/l, final treated effluent 211 mg O_2/l

- the achieved results indicate the successful finishing of the 1. phase of the start-up.

4. It was suggested to stabilise the achieved results (approx. 1 week) and if the results stood acceptable, the rehabilitation of the next two ditches (No. 1 & 2) can begin.

5. The rehabilitated oxidation ditches should be operated as follows:

- the flow should be approx. 1000 m^3/d
- the oxygen concentration in the ditches should be min. 1.5 - 2.0 mg O_2/l. If less than these values, the actions, as presented in the letter "SOME MAIN PROBLEMS POSSIBLE TO APPEAR IN THE NEAR FUTURE DURING THE CETP AMBURTEC START-UP" (Annex 5.) should be undertaken.
- the concentration of the MLSS should be increased to approx. 3000 - 4000 mg/l (what corresponds with the settleable solids of approx. 300 - 400 ml/l (depending on SVI)). If the depletion of the oxygen appeared, the actions as presented in the letter "SOME MAIN PROBLEMS POSSIBLE TO APPEAR IN THE NEAR FUTURE DURING THE CETP AMBURTEC START-UP" (Annex 5.) should be undertaken.
- the concentration of the solids in the recycled secondary sludge should be as much as possible (but without the extensive increasing of the sludge layer in the secondary settling tank, and probable overflow of the sludge, together with the clear supernatant). The exact concentrations depend on the SVI, and can be approx. 8000 - 12000 mg/l. The settleable solids should be measured, and should be approx. 800 - 900 ml/l (the values of approx. 900 mg/l were measured sometime in the start-up period). The desired recycled sludge concentration should be controlled by the correction of the flow of secondary sludge recycling pumps. The improvisation for the secondary sludge recycling (because the capacity of the existing system could be inadequate) should be made according the instruction in the letter "SOME MAIN PROBLEMS POSSIBLE TO APPEAR IN THE NEAR FUTURE DURING THE CETP AMBURTEC START-UP" (Annex 5.).
- all necessary analytical parameters (SS, COD, BOD, sulphides, chromium, MLSS, MLVSS, D.O.) should be measured regularly, not only for the oxidation ditches, but through the whole CETP.

6. The BIOTIM POLUTECH should rehabilitate the next two oxidation ditches (No. 1 & 2) a.s.a.p. (estimated time approx. 6 - 8 weeks).

7. The next two rehabilitated oxidation ditches (No. 1 & 2) should be tested and started-up similarly as the first two ditches (No. 3 & 4), but the procedure could be simpler

(separate seeding will not be necessary). After the plain water tests, and the operation of all aerators, the ditches should be feed with the mixture of the primary treated effluent and recycled secondary sludge, directly form the distribution box, firstly with approx. 10 % of the normal flow, and with stepwise increasing of the flow to the full flow, according the MLSS and D.O. concentration in the stared-up ditches. After the stabilisation of the results in all four ditches the 1. phase of the start-up can be considered as finished.

8. The biological treatment in all four rehabilitated ditches should be stabilised (designed concentration of MLSS, optimum concentration of D.O., quality of the treated effluent, etc.)

9. During the all activities in the contracted 6-moths period, the UNIDO RePO Chennai, should be regularly informed (by periodical reports (weekly, or phase-wise)), and especially immediately if some un-envisaged situation appear).

10. BIOTIM POLUTECH should transmit to UNIDO (and Amburtec) the correct installation drawings, correct aerators characteristics diagram and data, programme for start-up, 6-month operation, commissioning and presentation of the guaranty, and hand-over of the CETP, O & M manuals for the purchased and installed equipment and the whole CETP, and final report which should include all data collected during the 6-months period of the operation and final results.

11. Because, neither any installation drawing, nor any aerator characteristics diagram and the calculation, were not presented it was not possible to check the correct position of the installed aerators in the ditches. The provisory measured surface moving velocity in the ditches is some lower than asked. Visually, it seems that the distance between the partition wall and the aerator's turbine is too important, what can be the reason for some lower moving velocity, due to the by-passing of the great amount of the liquor, instead moving thorough the ditch. Such installation was explained by BIOTIM POLUTECH as the worry for the structural stability of the partition wall. The problem was discussed in the UNIDO RePO, and it was agreed, that it could be possible to lengthen the partition wall by the RCC wall which can be connected to the RCC platform and only placed on the ditches bottom (without any foundation), if, after the correct moving velocity measuring, and the check of probable sludge settling in the ditch, it will be necessary. For the probable works, a experienced civil works designer should be engaged. The final conclusion should also be made for the probable outside and partition walls increasing, if necessary.

12. All guaranteed parameters with the designed flow and raw effluent quality should be checked and confirmed by BIOTIM POLUTECH in the last months of the 6-months start-up and commissioning period (oxygenation capacity of the aerators, moving speed in the ditches, treated effluent quality (according the standards, except TDS, chlorides and sulphates).

13. CETP Amburtec should finished all activities of the 1. phase of the CETP rehabilitation (raw effluent pumps, full set of the aerators in the equalisation tank, rectification of the bottom of the clariflocculator, construction of the second secondary settling tank with the secondary sludge recycling system, electrical installation, etc.).

14. CETP Amburtec should improve the house-keeping of the CETP and the maintenance of the all installed equipment. Some improvement can be also made in some other parts of the CETP (not included in the 1. phase of the rehabilitation), according the suggestion in the TEH documentation, and according the own experience.

15. CETP Amburtec should undertake many actions for the optimisation of all other treatment steps at CETP (out of scope of BIOTIM POLUTECH responsibility) (equalisation and sulphide oxidation, primary physical-chemical treatment, sludge dewatering, etc.).

16. CETP Amburtec should be ready to take-over the rehabilitated CETP from BIOTIM POLUTECH, after final commissioning and finishing of the contracted 6-month period, either by own CETP staff, or by contracted O & M company, and to continue the correct operation and maintenance.

17. Although it was clearly suggested in the documentation prepared by the subcontractor, TEH-PROJEKT HIDRO, not to construct any tertiary treatment before the rehabilitation of the existing CETP, and especially rehabilitation of the secondary biological treatment in the oxidation ditches, and the collection of all necessary data on the rehabilitated CETP, the tertiary treatment unit was constructed (not yet started). As said in TEH's documentation, it was expected that it will be possible to achieve the asked treated effluent standards with secondary treatment only (except TDS, chlorides and sulphates), and maybe only COD could be some over the standards (250 mg O_2/l), due to the possible use of the different non-biodegradable chemicals in the leather processing, what can not be controlled by CETP. If the preliminary good results of the 1. phase of rehabilitated CETP start-up will be finally confirmed, the tertiary treatment will really not be necessary, and can be kept only as spare unit, for the probable temporary problems.

18. Although this was the last subcontractor's (TEH's) mission in the scope of the subcontractor's activities, and with this report and the Final report this subcontract should be closed, the subcontractor (TEH-PROJEKT HIDRO) is ready to accept the probable UNIDO demand for the additional service in the last phase of the commissioning, if it will be estimated as necessary or useful.

4. CONCLUSIONS AND RECOMMENDATIONS

Based on the all cited activities and the findings, the final conclusions and recommendations were as follows:

1. The existing CETP could not produce the treated effluent conform to existing discharge standards due to the problems existing in the CETP functioning (by design errors, construction, equipment selection and quality, management, maintenance etc.).

2. Many experts inspections were organised to the CETP, many reports and studies were prepared as the attempts to upgrade the existing CETP. Practically all previous document contain the similar conclusions on the CETP problems, but the suggestion to solve these problems were different. Some of the authors suggested the maximal possible use of existing facilities, but some suggested the construction of important new civil work structures and facilities.

3. The upgradation of the CETP was really necessary, because some of the equipment was in the very bad condition and provisory solution could not be also the final solution. The most urgent problem was the aeration systems in the aeration tanks and oxidation ditches, secondary settling and change of some destroyed equipment. The activities of second priority were the upgradation of some treatment steps for achieving the better operation results and/or easier operation, and the replacement of some other equipment, now in the bad conditions.

4. According the contract and Terms of Reference (TOR), Teh-projekt's made a comprehensive techno-economic study with in-depth assessment of the CETP and of suggestions made earlier and recommendations of the actions to be taken to rehabilitate and upgrade the CETP to be able to meet the discharge standards for main parameters.

5. Specific actions to be taken during Phase I were:

   - **Installation of reliable submersible pumps for raw effluent**

   - **Reconstruction of the existing equalisation tank (elimination of the submersed walls) and installation of the adequate mixers/aerators.**

   - **Installation of the appropriate and reliable aeration systems in the aeration tanks (oxidation ditches) including the necessary tanks reconstructions.**

   - **Construction of the new secondary settling tank**

6. Recommendations for Phase II were:

- Installation of the coarse screens at the effluent inlet
- Installation of the coarse pre-settler
- Installation of the fine automatic screen
- Construction of new sludge drying beds
- Installation of the new flocculator mixer and sludge scraper in the primary clariflocculator.
- Activation of some of 24 tanks (previous anaerobic contact filters) as the first step of biological aerobic activated sludge treatment, by reconstruction of the pipeline systems for the primary treated effluent and recycled sludge. This step should taken only in case the biological treatment in the oxidation ditches will be insufficient (especially during peak periods). The existing aspirating and submersible aerators from the oxidation diches (where the new aerator will be installed) will be used for their aeration
- Installation of measuring channel at the effluent outlet in order to have the possibility for on-line control of the final treated effluent.
- Reconstruction of the secondary sludge pumping system (pumps and pipeline). The final decision will depend on the outcome of verification of the actual situation as it is not sure whether the data available about this system are correct.
- Upgradation of the electrical installations
- Upgradation of the on-line instrumentation and introduction of automatic control in order to better monitor and control the treatement process.
- Setting up of the tertiary treatment. The necessity to set it up will depend on the quality of treated effluent produced by the rehabilitated and upgraded CETP.

The installation of the new flocculator mixer and sludge scraper in the primary clariflocculator, was in the further discusion and agreements moved from the Phase II to the Phase I.

7. The main problem was the selection of the supplier for the main activity of Phase I, financing by UNIDO, the "**Installation of the appropriate and reliable aeration systems in the aeration tanks (oxidation ditches) including the necessary tanks reconstructions**", beacuse any producer of the aerators in India did not have expereince with the installation of the aerators in the oxidation ditches. The brush type of the aerators, suggested by TEH-PROJEKT HIDRO, as the best asolution for the CETP Amburtec rehabilitation, were practically not produeced in India (the attempt to produce the brush aerator, by copying some western aerator, firstly installed at CETP Amburtec, was not succesful), and the costs for the imported aerators were very high.. Finally, the offer from Indian company **"BIOTIM POLUTECH"** for the fixed surface aerators was selected.

8. For the other activities of Phase I, financing by AMBURTEC, the following Indian companies were selected:

   - **Installation of reliable submersible pumps for raw effluent: FLUIDLINE (KSB)**

   - **Reconstruction of the existing equalisation tank (installation of the adequate mixers/aerators): ENVIRO SCIENCE**

   - **Installation of the new flocculator mixer and sludge scraper in the primary clariflocculator: BIOTIM POLUTECH**

   - **Construction of the new secondary settling tank: BIOTIM POLUTECH**

9. Some of the planned activities at CETP Ambur for the 1. phase of the CETP's rehabilitation were finished (installation of three new aerators in the equalisation tank, reconstruction of the clariflocculator, rehabilitation of first two oxidation ditches (No. 3 & 4)), and some activities (civil works structures the equipment) are under construction and installation (purchase and installation of the new two raw effluent submersible pumps in the receiving sump, repair of two existing aerators for the equalisation tank, rehabilitation of the next two oxidation ditches (no. 1 & 2), construction of the new secondary settling tank with secondary sludge recycling system)

10. The first two rehabilitated oxidation ditches were started-up and the situation at the end of this phase of the start-up was as follows:

   - flow: approx. 1000 m^3/d
   - Settleable solids: ditch No. 3: 120 ml/l, No. 4: 140 ml/l
   - Settleable solids in the recycled secondary sludge: 200 - 400 mg/l (sometime (after previous shut-of of the pumps, for some longer time) approx. 900 mg/l)
   - MLSS: ditch No 3: 1814 mg/l, No. 4: 2182 ml/l
   - SVI: ditch No. 3: 66 ml/g, No. 4: 64 ml/g
   - COD: equalisation tank: 1610 mg O_2/l, primary treated effluent: 1150 mg O_2/l, oxidation ditch No. 3: 243 mg O_2/l, oxidation ditch No. 4: 238 mg O_2/l, final treated effluent 211 mg O_2/l
   - the achieved results indicate the successful finishing of the 1. phase of the start-up.

11. The BIOTIM POLUTECH should rehabilitate the next two oxidation ditches (No. 1 & 2) a.s.a.p. (estimated time approx. 6 - 8 weeks). The next two rehabilitated oxidation ditches (No. 1 & 2) should be tested and started-up similarly as the first two ditches (No. 3 & 4). After the stabilisation of the results in all four ditches the 1. phase of the start-up can be considered as finished.

12. BIOTIM POLUTECH should transmit to UNIDO (and Amburtec) the correct installation drawings, correct aerators characteristics diagram and data, programme for start-up, 6-month operation, commissioning and presentation of the guaranty, and hand-over of the CETP, O & M manuals for the purchased and installed equipment and the whole CETP, and final report which should include all data collected during the 6-months period of the operation and final results.

13. All guaranteed parameters with the designed flow and raw effluent quality should be checked and confirmed by BIOTIM POLUTECH in the last months of the 6-months start-up and commissioning period (oxygenation capacity of the aerators, moving speed in the ditches, treated effluent quality (according the standards, except TDS, chlorides and sulphates).

14. CETP Amburtec should finished all activities of the 1. phase of the CETP rehabilitation (raw effluent pumps, full set of the aerators in the equalisation tank, rectification of the bottom of the clariflocculator, construction of the second secondary settling tank with the secondary sludge recycling system, electrical installation, etc.).

15. CETP Amburtec should improve the house-keeping of the CETP and the maintenance of the all installed equipment. Some improvement can be also made in some other parts of the CETP (not included in the 1. phase of the rehabilitation), according the suggestion in the TEH documentation, and according the own experience.

16. CETP Amburtec should undertake many actions for the optimisation of all other treatment steps at CETP (out of scope of BIOTIM POLUTECH responsibility) (equalisation and sulphide oxidation, primary physical-chemical treatment, sludge dewatering, etc.).

17. CETP Amburtec should be ready to take-over the rehabilitated CETP from BIOTIM POLUTECH, after final commissioning and finishing of the contracted 6-month period, either by own CETP staff, or by contracted O & M company, and to continue the correct operation and maintenance.

18. Although it was clearly suggested in the documentation prepared by the subcontractor, TEH-PROJEKT HIDRO, not to construct any tertiary treatment before the rehabilitation of the existing CETP, and especially rehabilitation of the secondary biological treatment in the oxidation ditches, and the collection of all necessary data on the rehabilitated CETP, the tertiary treatment unit was constructed (not yet started). As said in TEH's documentation, it was expected that it will be possible to achieve the asked treated effluent standards with secondary treatment only (except TDS, chlorides and sulphates), and maybe only COD could be some over the standards (250 mg O_2/l), due to the possible use of the different non-biodegradable chemicals in the leather processing, what can not be controlled by CETP. If the preliminary good results of the 1. phase of rehabilitated CETP start-up will be finally confirmed, the tertiary treatment

will really not be necessary, and can be kept only as spare unit, for the probable temporary problems.

19. Although this was the last subcontractor's (TEH's) mission in the scope of the subcontractor's activities, and with the Final report this subcontract should be closed, the subcontractor (TEH-PROJEKT HIDRO) is ready to accept the probable UNIDO demand for the additional service in the last phase of the commissioning, if it will be estimated as necessary or useful.

20. UNIDO RePO should continue to follow the results of the rehabilitation of the CETP AMBURTEC, not only to the final commissioning and hand-over, but also further on, to be able to compare the results of this method of the biological activated sludge treatment (oxidation ditches) with other methods, applied in the other (C)ETPs in Tamil Nadu, India, especially where the UNIDO was involved.

21. **If all guaranteed parameters with the designed flow and raw effluent quality will finally be confirmed (oxygenation capacity of the aerators, moving speed in the ditches, treated effluent quality (according the standards, except TDS, chlorides and sulphates), this will be practically the first tannery (C)ETP (and maybe also the first (C)ETP for any waste waters) with the oxidation ditches for the aerobic activated sludge treatment in India, especially using the domestic (Indian) fixed surface aerators, and this (C)ETP could be used as the demonstration unit.**

ANNEX 1.

Terms of Reference (TOR)

17 June, 1998

US/IND/97/124
TERMS OF REFERENCE
FOR SUBCONTRACTOR SERVICES

TERTIARY TREATMENT AND REHABILITATION OF THE COMMON EFFLUENT TREATMENT PLANT, (CETP) AT AMBUR

A. Background information

Brief Description of the project:

The project addresses the issue of containment of environmental degradation emanating from the tanning industry in the state of Tamilnadu, India. The state of Tamilnadu is the most important leather producing center in India. The leather industry generates not only foreign exchange but is also an important employment provider. Weaker sections of the society are traditionally employed in the industry. In downstream processing of leather women are the main workforce.

This project is the logical successor of the "Phase I" project US/IND/90/244 ***Assistance in the treatment of tannery effluent in the state of Tamilnadu, India*** in which four cleaner technologies were introduced and demonstrated and technical assistance was provided to two common effluent treatment plants and two individual treatment plants. Whilst the project has successfully met its objectives and outputs and has achieved improved environmental practices in the industry on a practical level, not all technical issues could be dealt with. Under this "Phase II" project unresolved technical issues from the "Phase I" project are being dealt with. One of these unresolved issues is given below :

Disposal of treated effluent

In the state of Tamilnadu, approximately 30,000 m^3 of treated tannery effluent is discharged every day in the environment. In view of impending water shortage in some of the main tannery areas and the high potential nutrient value of treated effluent, it is considered worthwhile to demonstrate, in a CETP, improving further the quality of treated effluent by installation of a tertiary treatment unit to enable its application for some operations of the tannery and the use of treated effluent for irrigation of trees and plants.

Therefore under the project the Ambur CETP has been selected as a site for the basic tertiary treatment system using treated tannery effluent for irrigation purposes before final discharge. However, in the current scenario, CETP not meeting the standards, rehabilitation of CETP and corresponding improved treatment results are expected to improve the performance of the irrigation experiment.

The Ambur CETP is located at Thuthipet village. The treatment capacity is 2200 m^2 / day catering to needs of 50 tanneries. The segregated effluent other than soak liquor is collected through a 10.5 KM gravity and pumping mains. The CETP system contains collection tank, equalization cum mixing system, physio chemical treatment., two stage biological system including oxidation ditch, secondary treatment and sludge drying bed. The CET is also having a reasonably well equipped laboratory for regular analysis of water for the CETP.

Tertiary treatment of tannery effluent has been identified by the authorities as one of the essential prerequisites of meeting the pollutant discharge standards. Whilst many treatment plants are able to meet many of the pollutant discharge standards as prescribed by the authorities, it has been further observed that some of the strictly not technical but highly visible standards such as colour removal are not easily achieved. In view of the many CETPs operational in the state of Tamilnadu, the current practice of discharging treated effluent in the semi-arid lands of Tamilnadu presents loss of a valuable resource. It has been acknowledged that after tertiary treatment system at least part of the treated effluent can be reused elsewhere.

The project US/IND/97/124 forms part of the UNIDO Regional Programme for Pollution Control which addresses the issue of containment of environmental degradation emanating from the tanning industry in the region. Under this "umbrella project" appropriate cleaner production methods, efficient and cost effective end of pipe treatment of tannery effluent, conversion / utilisation solid wastes from tanneries and/or disposal etc. are demonstrated through establishing Pilot and Demonstration Units (PDUs). Model common effluent treatment plants will be established to demonstrate the design, operation and maintenance of tannery effluent treatment. These will be used as training grounds for operators from other CETPs in India and from other countries of the region.

Under the project US/RAS/92/120 basic information has been collected on operational aspects of the Ambur CETP. Also under the same project US/RAS/92/120 the capacity to develop optimum treatment systems has been highlighted. In this respect rehabilitation of existing CETP at Ambur with all proper documentation will serve as a guiding principle for future rehabilitation of effluent treatment plants. The CETP will greatly benefit from this blueprint since currently it is not meeting the standards and many of the consultants who visited the CETP have given different technical views and opinions.

B. Objective / output

In conformity with information and explanation provided earlier, the objective is to prepare the blue print for rehabilitation of the Ambur common effluent treatment plant and to review in detail the design for the irrigation experiment at Ambur CETP.

C. Suggested location

The Regional Programme Office of UNIDO in Madras (RePO), in consultation with potential recipients of technical assistance has identified the common effluent treatment plant (CETP) in Ambur, North Arcot District of Tamilnadu.

D. SERVICES TO BE PROVIDED

In order to produce the outputs mentioned earlier the subcontractor, acting as the main source of technical expertise on the design engineering aspects of the rehabilitation plan and design of irrigation experiment, will provide the following services:

The Regional Programme Office of UNIDO in Madras, in consultation with the pre-identified common effluent treatment plant at Ambur (rehabilitation and irrigation) will collect and prepare all necessary information.

D. 1. Responsibilities of the subcontractor

D.1.1. Rehabilitation design for Ambur CETP

D.1.2. Review report on existing facilities including effluent drainage system from tanneries and operational performance of the CETP

D.1.3. Detailed rehabilitation plan including design drawings, equipment specifications. Plan will also include options for improvement of treatment units, additional viable physical, chemical, biological and tertiary system including estimated costing, anticipated improvement in treatment results

D.1.4. Technical assistance on implementation.

D.1.5. Irrigation plan.

D.2. Direct technical inputs

The subcontractor shall provide the following services as a total package.

D.2.1. Rehabilitation design for Ambur CETP

D.2.2. Detailed technical assessment of existing facilities and operational performance of CETP (field mission)

D.2.3. Rehabilitation plan comprising objective, current and future feasible situation, interventions, viable options, design drawings, detailed equipment specifications for approved option, estimated costing of various interventions and O & M cost including guidance for implementation.

D.2.4. Technical guidance and assessment of implementation of the improved systems through home base work (evaluation of quotations, inspection of equipment delivered, guidance in installation, test run etc.) and two additional field missions.

D.2.5. Technical review of design for irrigation plan (including hydraulic calculation etc.), direct detailed recommendations for improvement and monitoring parameters. Identification of success parameters.

D.3. Report

The subcontractor will prepare the Progress Reports and the Final Report reporting on the work carried out including designs, specifications list of (international) suppliers of equipment, recommendations for tannery effluent for treatment etc. The beneficiaries will provide access to sites for carrying out the activities outlined.

E. Time schedule for project implementation

Within one month from the date of confirmation of the award of contract by UNIDO the entire activities will be completed within thirteen months as per the following preliminary work schedule:

	Day
Briefing at UNIDO, Vienna of subcontractor's Team Leader/specialists	1
Home base review of available Ambur CETP project report and other technical reports and guidance for collection of additional information and review of data compiled and forwarded by RePO	15
First mission report comprising site inspection at Ambur CETP including waste water drainage system from tanneries to CETP, improved options, design including drawings, equipment specifications etc. for Ambur CETP rehabilitation, detailed review of design for irrigation using treated effluent prepared by national consultant	85
Second mission report (technical evaluation of quotations, supplementary information)	146
Third mission report (covering supervision of erection and commissioning of equipment and other facilities)	326
Draft final report	356
Review of draft final report by RePO	370
Final report submission	385
Total (in days)	385

F. MODALITIES OF IMPLEMENTATION

The subcontractor will in its work be guided, primarily through its Team Leader, by the Regional Programme Office of UNIDO located in Madras, India and will interact with the main subcontractor for technical inputs under the project, i.e. CTC, France as well as with the selected CETPs. The RePO will be in close liasion with the Project Manager at UNIDO, Vienna.

1. Period: Approximately 13 months, from June, 1998

2. Time input:

Field :	Total
Team leader (senior chemical/mechanical engineer with practical experience in tannery effluent treatment and site conditions in North Arcot district)	2.0 w/m
Civil engineer for detailed review of designs, structures drainage etc.	0.5 w/m
	2.5 w/m

Home base:

Team Leader (over period)	1.5 w/m
Civil engineer	0.5 w/m
Support staff	1.0 w/m
	3.0 w/m
Total:	**5.5 w/m**

Project team:

Senior chemical/mechanical engineer with detailed practical knowledge of tannery effluent treatment and experience with site conditions (Team leader).
Civil engineer with detailed practical knowledge of all treatment units for tannery effluent
Support staff, typist etc..

Reporting:

Reporting will consist of papers containing specific technical inputs such as detailed design for rehabilitation of Ambur CETP, specifications, cost estimates, detailed review of design for irrigation experiment etc. One final report will be submitted as per the format prescribed by UNIDO. At the end of the period a draft final report will be submitted and following evaluation of the draft final report the sub contractor will submit a final report.

Work plan:

The subcontractor will prepare the preliminary work plan and detailed action plan which will be elaborated in more detail in co-operation with the Programme Coordinator, RePO. The work plan and detailed action plan will only be updated, if special need arises.

Implementation Arrangement:

The staff of Regional Programme Office, UNIDO, 1ST Floor, TNPCB Building, 100, Anna Salai, Guindy, Madras 600 032, India.
(Tel: 91-44-2353158/2354518, Fax: 91-44-2353156, E-mail : unido@giasmd01.vsnl.net.in)
will implement the project under the guidance of Leather Unit of UNIDO, Vienna. The main subcontractor for technical inputs under the project US/RAS/92/120 (CTC, France), the selected tannery, tannery associations and concerned government departments in India and other countries participating in the regional programme for pollution control in the tanning industry in South East Asia will also be actively associated in the process of implementation of the project.