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

US/RAS/92/120-MODEL CETPs

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COMMON EFFLUENT TREATMENT PLANT KOLKATA LEATHER COMPLEX KOLKATA, INDIA

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LIST OF SYMBOLS & ABBREVIATIONS

BOD_5	Biological oxygen demand
BOT	Build-operate-transfer
CCRP	Central chromium recovery plant
CETP	Common effluent treatment plant
KLC	Kolkata Leather Complex
CLRI	Central Leather Research Institute
COD	Chemical oxygen demand
GoWB	Government of West Bengal
ha	Hectares
INR	Indian Rupees
m	meter
mg/l	milligram/litre
mm	millimeter
MLD	Million litres per day
MoEF	Ministry of Environment and Forests
HDPE	High density poly-ethylene
PE	Poly-electrolyte
PVC	Poly-vinyl chloride
SWCD	Solid waste collection department
SWDD	Solid waste disposal department
SWDS	Solid waste disposal system
SWMS	Solid waste management section
UASB	Upflow anaerobic sludge blanket system
UNIDO	United Nations Industrial Development Organization
UNIDO-RePO	UNIDO Regional Programme Office
US-EPA	United States Environmental Protection Agency
WBPCB	West Bengal Pollution Control Board

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1. INTRODUCTION

Kolkata, the capital of West Bengal state in India, is an important tanning centre of India. Currently there are 538 tanneries operational in Kolkata, distributed over 3 clusters.

- Tangra with 267 units, processing mainly hides and an estimated production capacity of 31 million m^2 leather per year (565 t hides per day)
- Tiljala with 223 units, processing mainly hides and an estimated production capacity of 7 million m^2 leather per year (125 t hides per day)
- Topsia with 48 units, processing mainly skins and an estimated production capacity of 14 million m^2 leather per year (160 t hides per day).

The tanning activity in these clusters started several decades ago when these areas were away from the populated parts of the city of Kolkata. But of late these clusters have come well within densely populated areas of the city.

The total estimated production capacity equals 52 million m^2 leather per year (850 t hides per day). However, the current reported leather production is less than 50% of the estimated capacity (about 23 million m^2). Chrome tanning is predominantly applied (85%), whereas vegetable (bag) tanning is of less importance (15%). According to CLRI, the number of workers employed in the tanneries is about 30,000.

The tanneries are currently surrounded by densely populated residential areas. There is thus no space for installation of pollution control systems, expansion or modernization. The environmental problems in these areas have become serious due to the absence of wastewater and solid waste management systems. The tanneries discharge their wastewater into roadside drains, which due to frequent blockages, cause flooding of streets and premises. Solid wastes are disposed in a completely uncontrolled manner. Stench from the tannery clusters is continuously present in the surrounding area. The effluent receiving waters, the Bhangar and the Beleghata canals, are seriously polluted.

In 1999, the CLRI prepared an inventory of the operational tanneries in the 3 clusters. The report summarises data on 303 existing tanneries with respect to production processes and quantities:

- Raw-Wet blue- Finished leather: 206 units processing about 490 t hides per day
- Crust- Finished leather: 26 units processing about 142 t per day
- Mixed processes: 2 units processing 1.3 t per day
- Wet blue - Finished leather: 33 units processing 240 t per day
- Raw - Wet blue: 34 tanneries processing about 109 t per day

2. KOLKATA LEATHER COMPLEX

Government of West Bengal had decided in as early as 1992, that the tanneries had to be relocated to a new modern complex, complete with a CETP to properly treat the effluent discharged. CLRI, Chennai had prepared & submitted a concept report in this regard in 1993, under the UNIDO-assisted National Leather Development Programme. The GoWB began to take steps towards implementation of the Kolkata Leather Complex soon after.

However when the complaints regarding the environmental pollution from these tanneries became strident, considering all related aspects, the Supreme Court of India directed the tanneries in 1996 to migrate to the new complex to be developed by the state Government.

The order of the Supreme Court gave an added impetus and speed to the implementation of the Kolkata Leather Complex already begun by the government. It was decided that this complex would accommodate all industrial and commercial activities related to leather manufacture and production of leather goods. For this purpose 438 ha land had been identified in the district South 24 Parganas, about 22 km from Kolkata on the eastern side of the E.M. Bypass, along the road from Kolkata to Basanti and adjacent to the SWF (or Bhangar Kata) canal. Much of the land being government property, the possession of such land was taken over by the GoWB.

The State Government decided to implement the KLC project on BOT basis as it neither had the technical expertise nor the resources. The BOT contract was awarded to M.L. Dalmiya & Co. Ltd., 32, Shakespeare Sarani, Kolkata in 1997.

Until now, 300 ha of land has been taken possession of and 84 ha is currently being purchased. An area of 54 ha is under litigation. Work on construction of the KLC started in 1997. Current works include land filling, construction of roads, canals and water bodies. The ground level of the entire area has been raised by about 1 m by land filling. The area is completely flat. The ground level is 1.8 m below the level of the Kolkata - Basanti road.

The estimated total electricity requirement of KLC is 80 MVA. Electricity will be supplied by WBSEB at l32 KV level. A sub station has been set up by the GoWB.

Water will be supplied by the BOT contractor from groundwater resources by means of 25 tube wells, each at a depth of 300 m with an estimated yield of 36.75 MLD, which is sufficient to meet the demands of the KLC. Additional water supply will be provided from surface waters within the KLC area, which provides for the harvesting of rainwater in ponds and canals within the complex.

The KLC is subdivided into 7 different zones:

- Zone 1, located in the eastern part of KLC. The chemical units, raw material market, common processing zone, by-product area and the CETP will be located in this. Zone 1 covers an area of about 76.7 ha.
- Zone 2 with an area of about 237.8 ha will provide space for all tanneries.
- Zone 3 with an area of about 50 ha will provide space for shoe and leather goods factories. Water bodies and green belts are also located in this zone.
- Zone 4 with an area of about 23 ha will accommodate small-scale leather goods unit.
- Zone 5 with an area of about 43.4 ha would be the KLC business district, with space for hotels, shopping centres, housing, museum, trade mart, administrative offices and the telecommunications centre.
- Zone 6 with an area of about 12.5 ha, is the theme park, including a research and

development centre and an exhibition area.
- Zone 7 with an area of 13.5 ha, is the strip of land between the main road and the KLC area. It will be used mainly as the transport yard and for security facilities.

For the CETP a site of 8.7 ha has been made available in the eastern part of KLC. Directly to the south of the KLC an area of about 20.2 ha will be used for solid waste and sludge disposal. When fully developed the KLC will provide about 80,000 jobs, including 33,000 in tanneries.

3. ENVIRONMENTAL IMPACT

A detailed Environmental Impact Assessment (EIA) of the KLC had been done and a report prepared in 1997. The report pays attention to all environmental, demographic, socio-economic, geographical, hydrological, ecological and spatial aspects of the establishment of the KLC.

The land, on which the KLC will be built, is mainly used for agriculture (paddy). As such the development of KLC will result in the loss of about 400 ha agricultural land, with related loss of paddy production and employment for the farmers (about 1,060 jobs). On the other hand the development of KLC will result in direct employment to about 80,000 people.

It is not expected that the establishment of KLC will lead to a loss of valuable ecological resources and water resources. If KLC operates well, it would lead to an improvement of the surface water quality in the area because the discharge of untreated tannery effluent in the open drains will stop as a result of the closure of the tanneries in their current locations.

It is not expected that the functioning of KLC will cause deterioration of the ambient air quality in the area.

4. PLANNING OF EFFLUENT MANAGEMENT IN KLC

A CETP has been planned for the KLC. In anticipation of phased migration of tanneries to KLC, it has been proposed to construct the CETP in six modules, each of 5,000 m^3/d. The treated effluent of the CETP will be discharged into one of Kolkata's storm water drainage canals, the Karaidanga (or SWF) Canal, transporting drainage water from Kolkata to a tidal river, which flows into the sea (Bay of Bengal).

The SWF canal has a maximum carrying capacity of 4,966 cusec (= 140 m^3/s). During the dry season the flow rate in the canal is about 500 cusec. At its full capacity (6 modules) the CETP will discharge about 30,000 m^3/d (= 12.2 cusec), which is a small quantity in proportion to the total water carrying capacity of the canal.

The United Nations Industrial Development Organization (UNIDO), in agreement with the United Nations Development Programme and the Government of India, has provided technical assistance to the GoWB in designing one module of the CETP and corresponding solid waste disposal facilities.

5. CEPT – DESCRIPTION

5.1. Preliminary treatment in tanneries

For this purpose 3 different categories of tannery effluents are considered, respectively: (a) beamhouse liquor (b) chromium bearing spent tanning liquor and (c) all other wastewaters including washings. An appropriate on-site pretreatment system consists of separate systems for pretreatment of the beamhouse and other waste liquors on the one part and the waste chromium liquor on the other.

The system consists of the following components:

- Channel with 2 screens for retaining coarse materials
- Grit chamber
- Sedimentation (three alternatives)
- Sludge drying and storage bed

- Segregation of spent chrome liquor, its collection in a tank within the tannery, to be transported to CCRU or to the tannery's own chrome recovery unit

- Combining all other effluent, passing through a screen, grit chamber, sedimentation, removal of sludge.
- Final discharge channel with fixed grate prior to discharge into the KLC wastewaster collection network.

Three alternative systems of sedimentation have been considered:

1. Gravity fed sedimentation tank with a weir to retain the settled sludge and an effluent outlet below the water surface to retain grease and oil. Sludge is removed manually.
2. Identical as Alt. 1, but the sludge is pumped out of it.
3. Collection sump for beamhouse liquor, from where it is pumped into an elevated sedimentation tank with hopper bottom. The sediments are discharged into the sludge drying bed, and the supernatant is discharged into the collection & conveyance system of the CETP.

Each tannery will adopt any of these depending on its size and the volume of effluent discharged.

5.2. Sewerage and stormwater collection

Designs for wastewater collection, storm water drainage network and water supply networks are currently under finalisation. The storm water collection system consists of covered roadside canals which discharge into the ponds and the water bodies. The water supply consists of 2 networks, one for distribution of well water (domestic purposes) and one for distribution of surface water (mainly process water).

The sewerage system consists of a network of branch lines and main lines. The branch lines are made of HDPE pipes, with a minimum diameter of 200 mm. The main lines too are made of HDPE pipes. The main lines will have a maximum depth of 3.5 m below ground level and they will discharge into pump sumps, from where the wastewater will be pumped to the CETP. A minimum velocity of 1 m/s is maintained in the sewer pipes in order to minimise clogging and siltation risks. A mobile system for flushing and vacuum cleaning will be used for periodical cleaning of the sewerage system.

In the gravity network manholes are installed at 25 m intervals. Manholes are also installed at each bend and drop in the network and at each inlet of tannery wastewater into the sewer network.

The design of the network encompasses three wastewater pumping stations in the first phase of KLC. The gravity pipes flow out into the sumps of the pumping stations that subsequently pump the wastewater to the CETP.

The pumping mains are equipped with air release valves at certain intervals, in order to control the problem of likely build-up of H_2S in the pipes. These valves are located in well ventilated chambers.

The flat layout of the wastewater conveyance network, without any undulations and with the low designed velocity and pressure in the pumping mains, will suggest that no serious water conveyance problems are likely to appear.

A mobile system for flushing and cleaning will be used for keeping the collection network free of sediments and growth or scaling on the pipe walls. A jet rodding sewer cleaning machine will be used for this purpose. Maintaining unobstructed flow in the gravity pipes is extremely important especially for prevention of the build-up of H_2S gas in the network.

6. CETP – BASIC PARAMETERS & OPTIONS

6.1. Influent characteristics

One module of the CETP is designed for a flow of 5,000 m^3/d. The influent flow into the CETP consists of tannery wastewater, domestic wastewater from the tanneries, supernatant of the CCRP and leachate of the sludge and solid waste landfill. Typical effluent entering the CETP will have characteristics as described in the table below. The table also indicates the discharge standards to be achieved by the CETP, as prescribed by WBPCB.

Parameters	**Raw effluent characteristics**	**Final effluent discharge quality standards (WBPCB norm*)**
pH	8.0-9.0	6.5-9.0
BOD (3 days, 27 °C)	2,000 mg/1	100 mg/1
Suspended solids	4,000 mg/1	100 mg/1
Sulphide	150 mg/1	1 mg/1
Chromium	200 mg/1	2 mg/1
Oil and grease		10 mg/1

for discharge to inland surface water

The CETP module is currently designed for a final effluent BOD level of 80 mg/1 (This designed BOD level was chosen as a safety factor to minimise the chance that the final effluent BOD will ever exceed 100 mg/1).

However, it may be possible that stricter final effluent quality standards are imposed in the future, e.g. for reaching an effluent BOD of 30 mg/1. When such a requirement is set, it will be necessary that additional aeration capacity is installed, not only for BOD degradation but possibly also for nitrification.

6.2. Alternative systems for tannery wastewater treatment

In implementation of the project various alternative wastewater treatment systems including UASB were evaluated and compared. After detailed evaluation by experts, the following system was chosen:

- Preliminary treatment consisting of screening, grit removal and equalisation
- Physical/chemical treatment
- High load activated sludge treatment.

7. FEATURES OF SELECTED TECHNOLOGY

7.1. Preliminary treatment

The preliminary treatment system consists of fine screens, grit removal, a distribution well and an equalisation tank. The wastewater from the collection network flows into a channel to fine screens which remove hair and other coarse solids; then, into a grit removal chamber, where easily settleable solids are separated from the wastewater. Each screen has a hydraulic capacity of 500 m^3/h of wastewater. The capacity of the grit chamber is 1,100 m^3/h of wastewater. The collected grit and fine screenings are disposed of with the sludge generated by the CETP.

From the grit chamber the wastewater flows into a distribution well. From here it is equally distributed to the CETP modules. First the wastewater enters the equalisation tank. This tank is equipped with an aeration system to prevent accumulation of solids and to provide for oxidation of sulphides. From the equalisation tank the wastewater is pumped at a continuous equal flow to the physical-chemical treatment unit.

7.2. Physical-chemical treatment (coagulation/flocculation/sedimentation)

In the physical-chemical treatment system the wastewater is mixed with specific chemicals, which enhance the separation of solids and chromium from the wastewater. Coagulating chemicals (e.g. aluminium sulphate) are added to promote the destabilisation of dissolved colloidal particles. Since the coagulation process is characterised by an optimum pH, chemicals for pH correction (usually lime solution) are added to the wastewater. For this purpose the pH of the equalisation tank is monitored continuously, using an automatic pH meter with a self-cleaning electrode. The actual dosage of chemicals is controlled automatically according to the measured pH value.

After addition of chemicals the wastewater flows into the flocculation tank, where the flocs of coagulated solids grow into larger and heavier particles. These subsequently settle at the bottom of the primary sedimentation tank. The flocculation process is improved by addition of anionic polyelectrolyte. The sludge from the primary sedimentation tank is pumped into a thickening tank, from where it is taken to the mechanical sludge dewatering plant.

About 80%of the suspended solids, 99% of chromium and 40% of BOD are recovered by physico-chemical treatment.

7.3. Biological treatment (high load activated sludge)

The overflow of the primary clariflocculator enters the aeration tank. Here it is mixed with flocs of aerobic micro-organisms (activated sludge). The wastewater and activated sludge are mixed and aerated by means of an aeration system, e.g. mechanical surface aerators or a diffused air system. The sludge flocs absorb suspended material. As they contain active aerobic micro-organisms, the organic matter is degraded aerobically. The organic matter acts as a substrate for the growth of new cells and as a source of energy. As a result the sludge mass in the aeration tank grows. Nutrients (N and P) may be added to the aeration tank contents in order to realise the optimum BOD/nutrients ratio of BOD : N : P = 100 : 5 :1. Tannery wastewater contains sufficient nitrogen but the phosphorus content is usually low and as such it may be necessary to add a phosphorus compound, e.g. superphosphate prior to biological treatment. The bio sludge/wastewater mixture flows from the aeration tank into the secondary clarifier, where the sludge settles at the bottom. The clear effluent flows out of the tank from the surface. Part of the sludge is recirculated to the aeration tank in order to maintain a constant concentration of activated sludge. The remainder of the sludge (surplus sludge) has to be removed.

A diffused air system has been chosen for aeration. It has been preferred over the surface aerators in view of higher oxygen transfer efficiency. There is plenty of experience in India in operation of diffused air aeration systems for tannery wastewater treatment.

7.4. Sludge treatment and disposal

The primary sludge and the surplus sludge from the secondary clarifier are pumped into the sludge thickening tank, where the dry solid concentration of the sludge will increase. From the thickener the sludge is subsequently conveyed to the mechanical sludge dewatering plant. To meet any emergency, some sludge drying beds are included in the system. The sludge can be diverted to these if and when the mechanical dewatering plant is out of operation.

7.5. Sludge and solid waste disposal

The sources of sludge generation are the primary and secondary sedimentation tanks, the grit chambers, the screens and the onsite preliminary treatment in the tanneries. The sludge from the primary clariflocculator is chemically precipitated organic and chromium sludge. The biological mass constitutes the sludge from the secondary clarifier. The mechanically dewatered sludge and the sludge from the drying beds will have different dry solids concentrations depending on the mechanism selected. For the design of the landfill, solids concentration of about 27% has been assumed. The disposal of sludge from the CETP has to be handled so as to minimise potential adverse impacts and to comply with the regulatory requirements. The estimated volume of sludge generated per day, when all the six modules of the CETP will operate, is 540 m^3 (27% concentration).

The estimated quantity of solid waste from the tanneries is 44 m^3 /d (for a capacity of 100 t/d). The solid wastes, to be disposed of, include raw trimmings, fleshings, wet blue trimmings, shavings and buffing dust.

According to the Hazardous Waste (Management and Handling) Amended Rules 2000 (effective from 5th January 2000), sludge containing more than 5,000 mg/kg of trivalent chromium and / or 50 mg/kg of hexavalent chromium from tannery wastewater treatment plants is categorised as hazardous waste. It is however anticipated that the total chromium concentration in the sludge from the CETP of KLC will be less than 2,500 mg/kg, if proper chrome segregation and recovery are ensured.

Until such time when proper chromium management measures are adopted by all the tanneries, the trivalent chromium concentration of the sludge may exceed the limit of 5,000 mg/kg. Thus, it is currently assumed that the sludge from CETP has to be handled as hazardous waste.

It has been recommended that the sludge be disposed of in a controlled landfill. In view of the potential for future utilisation of the sludge, it has been recommended that a landfill with a storage capacity for 5 years be established.

The main purpose of the safe landfill is to prevent and control the generation of leachate and its subsequent seepage into the ground. It is proposed to provide a HDPE liner below the drainage layer to prevent the seepage of leachate into the ground.

Design parameters for the first module of landfill / CETP are:

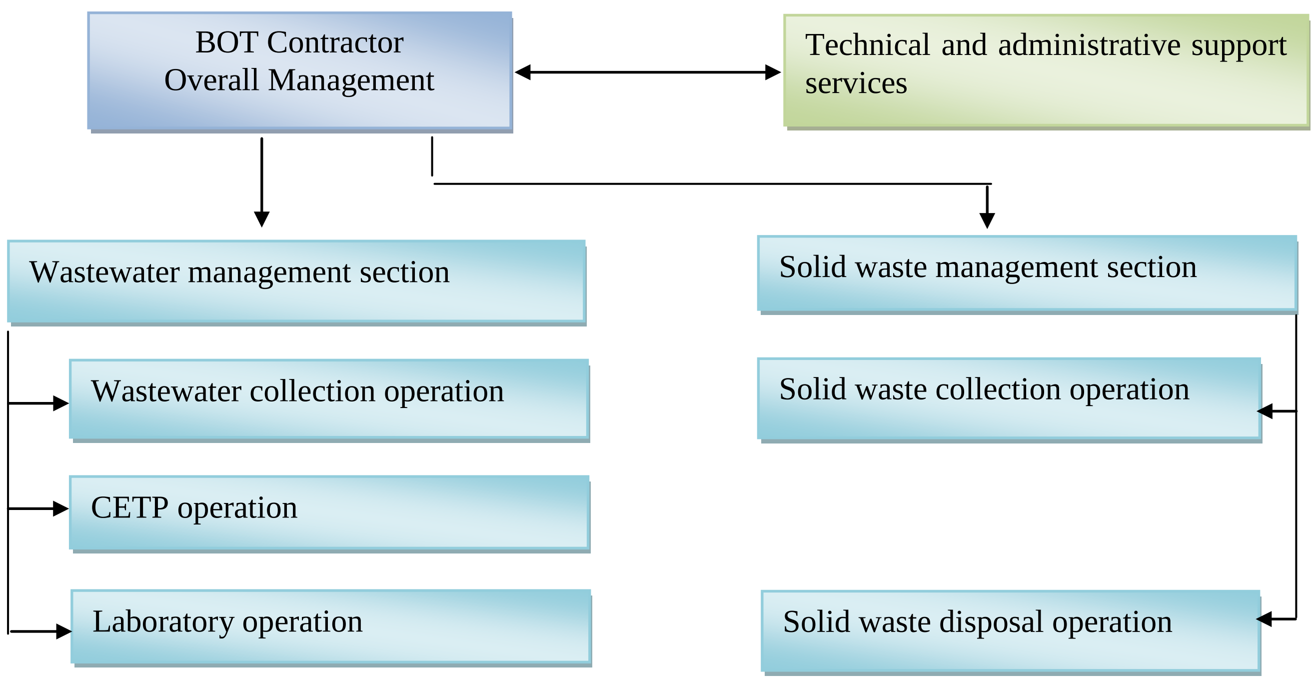
- Volume of wastewater: 5,000 m^3/d
- Sludge generation: 90 m^3/d (32,850 m^3 /y)
- Solid waste generation: 44 m^3/d (16,000 m^3/y)
- Annual rainfall: 1,600 mm
- Rainy days: Almost daily during the rainy season, May to October
- Depth of ground water table: 2 - 5 m
- Top soil: Semi impervious
- Land available: 20.23 ha or 202,300 m^3
- Design period: 5 years
- Sludge layer depth: 8 m
- Freeboard: 1.0 m
- Land earmarked by the GoWB: 20 ha

Operation and maintenance of the sludge and solid waste landfills will be supervised and monitored by the solid waste management section.

8. ORGANISATIONAL FRAMEWORK FOR WASTE MANAGEMENT

The BOT contractor will be responsible for protection of the environment in KLC. For this purpose the BOT contractor shall establish an appropriate Environmental Management System (EMS) in KLC. It is not within the scope of this project to contribute to the development of such an EMS for the KLC. The management of the wastewater and solid waste disposal is a key responsibility of the BOT contractor. As such the BOT contractor has to set up an appropriate organisation for operation and maintenance of the wastewater and solid waste facilities.

A possible organisational framework for operation and management of the wastewater collection and treatment system (further referred to as CETP) and of the solid waste collection and disposal system is shown below.



The major tasks of the BOT contractor in management of the wastewater and solid waste facilities are:

- overall technical management and support
- overall administrative management and support
- preparation and issue of environmental licences to the tanneries
- inspection and quality control, including compliance monitoring
- initiation and conduction of environmental investigations
- financial management of the systems
- determination of levies and penalties for wastewater discharge and solid waste production
- collection of levies and penalty charges
- reporting to government.

The responsibilities of wastewater management section are:

- management of operation and maintenance of wastewater collection, conveyance and treatment facilities
- inspection and investigation regarding water pollution problems
- assistance in determination of wastewater fees and penalties
- preparation of annual reports on functioning of the systems
- safety management
- quality assurance.

The solid waste management section (SWMS) is responsible for solid waste collection and disposal within KLC. As such the SWMS should monitor and supervise all related operations and ensure that the whole solid waste management system is operated in an environmentally sound manner. The major tasks of the SWMS are:

- overall management of solid waste collection, transportation and disposal facilities
- transportation of sludge and disposal in landfill site
- inspection and investigation with respect to solid waste related pollution problems
- assistance in determination of solid waste management fees and penalties
- preparation of annual reports on functioning of the system
- safety management
- assistance in determination of solid waste levies and penalty charges

9. PROPOSED WASTEWATER LEVY SYSTEM

The wastewater producers have to pay levies to the KLC management for covering the running costs of the wastewater collection network, the CETP and the sludge disposal system.

Options considered for determination of the wastewater treatment levies for the tanneries are:

- Calculation of the levy on the basis of the water consumption by the tanneries.
- Calculation of the levy on the basis of the production capacity, as tonnes per day
- Calculation of the levy on the basis of the actual pollution load of the wastewater discharged (as loads of BOD, suspended solids, sulphide and chromium)
- Calculation of the levy on the basis of the actual output (e.g. wet blue, crust or finished leather), e.g. as m^2 leather.

To start with, it has been recommended that Option 2 be used for calculation of the wastewater levy. In due course a more sophisticated levy system such as based on volume of effluent discharged and its pollution load could be considered. The levy may be charged on a monthly basis to enable smooth operation & maintenance of the system.

10. WASTEWATER LABORATORY

A wastewater laboratory will be established at the CETP. The major tasks of the laboratory are to sample and analyse effluent from the tanneries and other sources of wastewater within KLC, the sludge from the CETP and other solid wastes (as far as possible with the available analysis equipment in the laboratory). The laboratory is also equipped for routine physical/chemical monitoring of surface water and well water. The laboratory staff can also carry out a number of field analyses with mobile equipment, such as pH, dissolved oxygen and electrical conductivity.

The laboratory is equipped for the following analyses:

pH, electrical conductivity, dissolved oxygen, COD, BOD, chromium (total, 3^+ and 6^+) suspended solids, total solids, mohlman index, total kjeldahl nitrogen, total phosphorus chlorides, sulphides, sulphates.

The laboratory is proposed to be located on the ground floor of the administration building. The laboratory has an area of 60 m^2.

11. PROJECT IMPLEMENTATION

The BOT party would invite tenders based on the detailed tender documents prepared by UNIDO and award the work as a turnkey job to the successful tenderer. A high powered committee and a technical agency are expected to assist the BOT in this process.

An open tendering system has been suggested. To ensure the required quality control in project implementation, a dual pre-qualification system has been introduced. Detailed procedure for evaluation has been laid out. An evaluation committee for the evaluation of the offers received for CETP implementation has also been recommended.

The estimated duration of the tender procedure is 6 months.

After finalisation of the contract negotiations with the selected contractor the construction works will start. The estimated duration of the construction works is 2 years. Construction and installation works will be monitored and supervised by an Engineer, to be appointed by the BOT contractor, reporting to the Employer (BOT contractor) in close coordination with the Technical supervisor (engaged by the GoWB), reporting to the high-powered steering committee of the government.

After construction and commissioning of the CETP, the stabilization of the plant will start. It is foreseen that the process of stabilisation may take approximately six months. The CETP supplier will be responsible for further operation and maintenance of the CETP for a period of 6 months. During this period all problems and defects will be identified and mitigated. The supplier will also be responsible for training of CETP staff and for preparation of manuals for operation and maintenance. The defects liability period is one year.

12. COST

As per the detailed project report for the CETP, the installation and operating cost of one module of the CETP is as follows:

12.1. Capital Cost

Civil:	INR 47.50 million
Mechanical:	INR 38.55 million
Electrical:	INR 16.75 million
Piping:	INR 6.09 million
Instrumentation:	INR 7.34 million
Laboratory:	INR 2.04 million
CETP commissioning & stabilization	INR 6.11 million
Miscellaneous 10%	INR 12.44 million
Total:	**INR 136. 82 million**

12.2. Operating Cost:

INR 38.72 million p.a. or INR 25.82 per cubic meter or INR 0.93/kg of raw material processed

12.3. Landfill

The capital cost of landfill is estimated to be INR 112.17 million and the annual cost of operation is estimated at INR 3.83 million

13. PRESENT STATUS

The design, detailed engineering drawings and tender documents submitted by UNIDO to GoWB as part of the UNDP-project DG/IND/97/953, have been thoroughly evaluated by the technical committee of the GoWB and the MoEF, GoI and approved.

The MoEF, GoI, has agreed to provide 50% of the cost of the CETP, subject currently to a ceiling of Rs. 660 million, as an interest free loan to GoWB & the first installment of Rs. 50 million, already released.

The notice inviting offers for the construction of the CETP has been issued and offers are expected to be received by the end of November 2001. Two modules, each of 5,000 m^3/d capacity, will be taken up simultaneously.

It is foreseen that the award of work will take place before end of December 2001 & the first two modules of the CETP commissioned before the end of 2003.