CHAPTER 8

COMMON EFFLUENT TREATMENT PLANTS - A STUDY OF MANAGEMENT ISSUES

8.1 BACKGROUND

Leather industry has attracted a great deal of opprobrium in many developing countries in the recent past mainly on account of its rather poor record in treatment and management of its liquid and solid wastes. A sudden expansion of this industry in India and many countries of Southeast Asia in the past two decades, when many of these countries did not have appropriate and effective environment protection laws, has been responsible for increased pollution from this industry in these countries (Information Sources, UNIDO 1989). However, there has been a dramatic change in the situation in the past few years in many a country. National laws are in place and enforcement thereof is becoming more effective day by day. Public awareness has grown. International opinion against polluting industries such as leather in developing countries is threatening the booming export of products of such industries taking place from these countries. All these developments have brought to the centre stage the topic of dealing with the problem of tannery pollution. This has become critical for the survival and growth of the leather industrial sector in this region.
Though organised medium and large-scale tanneries are coming up, the preponderance of small-scale tanneries generally found in clusters is a prominent feature. Invariably the medium and large tanneries take measures to treat the wastes generated by them. However, this is not the case with the small-scale tanneries. Small-scale tanneries do not admit universal definition. There are small tanneries having one or two drums. The common features of small tanneries are primitive work methods, limited work space generally laid out haphazardly, severe financial constraints leading to virtual hand to mouth existence, non-availability of vacant land near the work shed, one-man operations with no support from technically qualified personnel and lack of awareness of damage to environment caused by solid and liquid wastes discharged. When the government and the public raised their voices against such unacceptable practices, the tanners had to find a solution. The one redeeming feature of these small-scale units is that these are found in clusters. This provided the opportunity for a group of contiguous tanneries joining together to treat the wastes generated by them. This gave birth to the concept of common effluent treatment plant, referred to as CETP. A CETP may be described as an effluent treatment plant designed to receive the liquid waste generated by a group of contiguous tanneries and treat this by application of an appropriate technology in a cost effective manner to achieve discharge standards prescribed by the pollution control authority and take appropriate measure to dispose the solid waste (sludge) generated in the process of treatment of effluent, in accordance with local laws and regulations.

8.2 MOBILISING TANNERS

The creation of a CETP first requires all tanners in contiguity to agree to join together. There has to be a strong motive for doing this. In
India particularly in Tamil Nadu, the tremendous pressure exerted by the pollution control authorities, the public and the courts of law has been the main driving force. Similar pressure is applied in varying degrees in different countries.

The pattern of organisation that has become popular in India is for a group of contiguous tanners to form themselves into a company by contributing towards its share capital. The company is charged with the responsibility of designing the plant, arranging finance, engaging contractors and implementing the project. Subsequently, the company is responsible for operation and maintenance of the project. In some parts of India, public sector agencies came forward to help the industry. For example, in Tamil Nadu State of India, the Tamil Nadu Leather Development Corporation, a State government owned company, came forward to mobilise the tanners in forming companies for setting up of CETPs in different clusters and later assisted these companies in sourcing requisite finance for the projects. However, the basic responsibility of construction, operation and maintenance of the plant remained with the company.

In Punjab State of India, the Punjab State Leather Development Corporation (PSLDC), a Government of India owned company created a new industrial complex for the leather industry at Jallandhar and a common effluent treatment plant is a part of this complex. Here this Corporation operates and maintains this plant as a part of its overall task of maintenance of the industrial complex. In the State of West Bengal, the Government has decided to relocate all the tanneries from the city of Calcutta and a private contractor has been engaged to build, operate and transfer (BOT) a leather industry complex, which will consist of common effluent treatment facility for the relocating tanneries. In India, as
Tannery clusters are found in small towns which do not have their own municipal treatment facilities for domestic waste, it has not been feasible for the tanneries to discharge their effluent after partial treatment into the sewer lines as is reported to be the practice in many countries of Europe. Whether the CETP is operated by the company of tanners or by an external agency, both the capital cost and operational costs are recovered from the tanners on a monthly basis in India.

8.3 ROLE OF GOVERNMENT

Keeping in view the fact that many industries are in the small-scale sector and these faces similar problems in dealing with treatment of their wastes, the Government of India launched a scheme of assistance to common effluent treatment plants. Under this scheme, if a group of small-scale industrial units formed a company to create a CETP or if an external agency came forward to create such a facility, 50% of the capital cost of the plant is provided as grant - 25% by the Government of India and 25% by the concerned State. Besides, loan upto 35% of the capital cost is provided by designated financial organisations in the country. This leaves a gap of only 15% percent of the capital cost, which is required to be contributed as promoter's equity. The promoters are free to contribute more to equity, thereby reducing the loan burden. This scheme of the Government of India gave a big fillip indeed for the promotion of CETPs particularly in the tanning industry. The Ministry of Environment and Forests, Government of India is administering this scheme.

8.4 PRESENT STATUS

As per 1999 data, there are 17 common effluent treatment plants for tanneries; of these, 12 are located in the State of Tamil Nadu, two in
A major tannery relocation project is under implementation in the State of West Bengal. These CETPs together treat effluent from over 850 tanneries. The West Bengal complex, when ready, will treat effluent from over 500 tanneries. With the completion of that, physical infrastructure for tannery pollution control in more than 80% of operating tanneries will be in place. It may be mentioned that of the 17 CETPs operated in the country, 15 are managed by companies created by tanners themselves and only two are managed by external agencies.

8.5 FEATURES OF CETP AND MANAGEMENT STRUCTURE

The management of each CETP company is entrusted to a board of directors, elected in terms of the provisions of the country's company law. The chairman of the board is a tanner. The other members of the board are also tanners. The board appoints a technically or otherwise qualified person as the General Manager of the plant who is responsible for the day to day operation and management of the plant. The General Manager thereafter engages key technical personnel. Some CETP companies have been operating their plants with the help of contractors. In such cases, the contractors bring in their expertise and personnel and only very few key personnel are engaged by the CETP company. The typical organisational pattern for a CETP is presented in Figure 8.1 and an aerial view of a CETP is shown in Figure 8.2.

A CETP generally consists of the following units:

1. Pre-treatment systems in tanneries
2. Collection and conveyance system
3. Receiving sump
Figure 8.1 Organisational model for a typical CETP
Figure 8.2 An aerial view of CETP
4. Screens and grit remover  
5. Equalisation tank  
6. Chemical dosing (flash mixer)  
7. Primary clarifier (Fig.8.3)  
8. Anaerobic/Aerobic treatment or two stage aerobic treatment (Fig.8.4 and Fig.8.5)  
9. Secondary clarifier  
10. Sludge thickener  
11. Sludge drying - mechanical or solar drying beds (Fig. 8.6)  
12. Discharge of effluent.

8.6 COMMON PROBLEMS IN CETP

The efficiency of a CETP depends on the efficiency of each individual unit, if any of these units does not work properly it will be reflected in the operation of other units and the overall efficiency of the plant. Most of the CETPs for treatment of tannery effluent are operating from 1996 onwards. During this period, valuable experience has been gained in operation and maintenance of CETPs. Based on the visit to these CETPs and discussion with the managers, operators and others concerned with the enforcement of environment law in the country the following have been identified as common problems:

1. Frequent disruptions in the conveyance system resulting in overflow of effluent

2. Shock loading and overloading of the CETP

3. Corrosion of machinery and equipment, breakdowns; below-rated-capacity performance of pumps, aerators, etc.
Figure 8.3 Primary clarifier
Figure 8.4 Anaerobic lagoon
Figure 8.5 Aerobic biological treatment
Figure 8.6 Sludge drying beds
4. Inefficient performance of various treatment units of a CETP much below the designed capacity

5. Inconsistent results in the effluent discharged after treatment

6. Difficulty in management and disposal of sludge generated


8.6.1 Design of the Plant

The key to successful operation of a CETP is its proper design. Proper design of the CETP calls for accurate data with regard to the quality and quantity of effluent generated in the cluster. Invariably it has been found that the tanners have either understated or overstated such figures for their own reasons. The result has been a CETP of either under or over capacity. This has been responsible for overloading of the CETP in some instances. Besides hydraulic load, the data relating to the characteristics of effluent have also not been faithfully reported. This data has a direct bearing on the design of the plant and choice of equipment. In the initial stages, the designers tended to design the plant based on data provided without critical analysis or cross verification.

8.6.2 Lack of Co-operation of Members

The design of the CETP is based on the assumption that the member tanners do pre-treatment of effluent before conveying it to the CETP. Such pre-treatment consists of removal of solids with the help of screens, setting of solids and conveying only liquid waste to the CETP.
Regular maintenance of pre-treatment system is a pre-requisite. Often when the pre-treatment system is blocked, the tanners bypass it and discharge the effluent direct to the conveyance system with all removable solids. No regular maintenance of pre-treatment system is done. Besides, some tanners also convey through the CETP pipeline all other solid wastes of the tannery. Absence of facility for separation of rain water from the CETP pipeline within the tannery also leads to overloading. Such callousness results in blockage of pipeline and overflow, a much higher presence of suspended solids in the effluent than originally anticipated and overloading the CETP.

8.6.3 System of Management

While some CETP companies directly manage the CETP with their own staff, others engage contractors. It has been generally seen that the contractors do not show needed commitment. Nor are they very well versed in the management of the CETP. As the CETP companies attempt to keep the contract fee as low as possible, the contractors have no compunction in cutting corners. Though the contractors may find short-term solutions, in the long term they cause great damage to the machinery and equipment of the CETP. Contract management of CETPs does not appear to be a desirable solution. Where the CETPs are managed by the companies themselves too, unfortunately properly qualified and minimum required technical personnel are not often engaged. Absence of qualified and trained personnel has been found to be responsible for poor maintenance, frequent breakdowns and higher cost of operation of CETPs.
8.6.4 Training

On the one hand, the CETP companies generally do not engage properly qualified personnel. On the other, even these people are not put through a proper training. Over a period of time, many of such personnel consider themselves experts not needing training. This is a dangerous situation. Training of all personnel, operators, supervisors and managers of the CETP is a must. Every CETP company should insist on this and arrange for this to achieve better results. Such training should be organised on an annual basis.

8.6.5 Maintenance

Regarding maintenance of machinery and equipment, the less said the better. No regular maintenance is resorted to. As the tannery effluent is very corrosive in nature, constant painting of the machinery and equipment is required to prevent corrosion. Lack of preventive maintenance results in frequent breakdowns and shorter life of machinery and equipment (Rajamani 1985). Besides, these are not able to operate at rated capacity.

8.6.6 Purchases

There have been instances of purchase of cheaper machinery resulting in serious problems of operation. But more significantly many CETPs do not purchase the chemicals of the right quality. This leads to poor operational results on the one hand and on the other hand the quantity of sludge generated too increases. Purchasing poor quality chemicals, in the hope of effecting economy, is being penny-wise and pound-foolish (Rajamani and Gupta 1989).
8.6.7 Modulation of Treatment Process

Tannery effluent being very complex and in a CETP the quality of effluent reaching being of different standards in different parts of the day and in different days, capacity to modulate the treatment process according to the effluent received is required. Many CETP companies lack this. First, a proper laboratory is needed. Secondly, a qualified laboratory technician, properly trained is needed. Thirdly, a system of analysis of effluent at different units of the CETP at regular interval is required. Fourthly, a manager who can interpret the results and appropriately modulate the treatment process vis-à-vis addition of chemicals, operation of aerators, etc., is needed. Though many CETPs have basic laboratories, in the absence of systematic analysis of the effluent and effective modulation of the process, the treatment is not always cost effective (Rajamani and Ramasami 2000). Lack of training and knowledge is responsible for this state of affairs.

8.6.8 Occupational Safety

One sadly neglected aspect of CETP management is occupational safety of the operators. Some of the units of the CETP, such as the conveyance system, manholes, receiving sump, are prone to generate toxic gases such as hydrogen sulphide. If not properly understood and preventive measures taken, exposure of workers to such toxic gases could result in death. Likewise, there are large water bodies in the CETP, such as the aeration tank, equalisation tank, anaerobic tank etc. If not properly guarded, workers may slip and fall in these. Handling of chemicals must be done with care. Electrical installations must be handled with care and using appropriate safety equipment. Lack of occupational safety results in
accidents and disruption of work besides exposing the CETP companies to
needless controversy.

8.7 DESIRABLE MANAGEMENT MODEL

The desirable management model is discussed under three heads viz., administrative, technical and financial management.

8.7.1 Administrative Management

From the experience in the last few years in India, it appears that contract management of CETPs has not been very effective. On the contrary, it is quite likely to result in major long-term problems. Accordingly, it is desirable that the CETP companies take over the management of the CETP in their own hands. Self-discipline among the member tanners of the company is a pre-requisite for efficient operation of the CETP. In order to achieve such self-discipline, it is suggested that each CETP company may prescribe a code of conduct for its future members. Any member violating such a code must attract immediate exclusion from the company.

Professional management of the CETP company is necessary. While the board of directors consisting of tanner members should essentially be concerned with the mobilisation of finance for operation and maintenance, loan repayment, enforcing discipline among the tanner members and maintaining smooth relationship with public at large, government agencies and other external agencies, the day to day running of the CETP company should be entirely left to a properly qualified general manager, duly assisted by key technical personnel as indicated in the organisation chart at Figure 8.1. The Board should necessarily set
specific standards relating to cost of operation and treatment results. Such a professional manager should thereafter be given full freedom in operation and maintenance of the plant. Training of managers, supervisors and operators is a must. Such training may be repeated at least annually.

8.7.2 Technical Management

Technical management of a CETP consists of the following components (Wastewater Management, CLRI 1997).

1. Monitoring of the operation and maintenance of pre-treatment and inplant control measures in the individual tanneries

2. Management of common collection and conveyance of wastewater

3. Common physico chemical and biological treatment and disposal of treated effluent

4. Disposal of sludge and solid waste management.

Depending upon the type of process and effluent conveyance system the tanneries are expected to provide pre-treatment units and segregation of certain streams such as soak/pickle and chrome liquor. The CETP management has to provide specific model design for implementation of the pre-treatment in each individual unit and monitor through the management committee and technical team. The CETP management shall prepare a proper maintenance schedule including check points and enforce the maintenance of the collection and conveyance systems. Proper safety measures need to be provided for the
maintenance staff. The CETP maintenance shall include proper plan and schedule of the operation of the physico chemical and biological units and proper plan for preventive maintenance, breakdown maintenance, overall maintenance and reconditioning. Suitable plan of action shall be made to minimise the volume of sludge generation and make the sludge less hazardous.

8.7.3 Financial Management

Financial management includes the following aspects:

1. Proper planning before and after the implementation of the project
2. Selection of suitable treatment system
3. Calculation of treatment costs
4. Distribution of treatment costs
5. Financial auditing
6. Liaison with statutory bodies for concessions, tax reductions etc.

8.7.3.1 Proper planning of financial aspects of the project

Proper planning during the conceptual stage itself is a prerequisite for a CETP project to be success. Implementation of the CETP within the estimated time frame and cost is the first step to proper financial management. The company must become effective from day one to achieve this.

Before commencing project implementation a cost sharing system, broadly acceptable to all members, should be evolved. If the cost sharing is to be done based on the effluent flow rate from tanneries, as is the case in
most CETPs, installation of flow measuring units in each tannery should be a part of the project.

8.7.3.2 Selection of a suitable treatment system

A careful evaluation of installation and operational cost of the proposed treatment system should be done first. Regional factors like cost and availability of land, cost and availability of construction materials, sludge disposal facilities etc must be taken into account. Selection of suitable technology (such as aerobic, chemical, anaerobic etc), construction modes (such as in RCC, rubble masonry, brick masonry etc) suitable site, considering terrain to facilitate pumping or gravity flows and other factors such as availability of chemicals, mode of disposal of treated effluent, availability of man power, accessibility, facilities for sludge processing and disposal etc are all important. Most of these options have a strong bearing on the operational cost of CETP. For example, a chemical treatment step may consume less area and relatively low installation cost. However, the same will substantially increase the operational cost as well as augment sludge disposal problem.

8.7.3.3 Calculation of treatment costs

Calculation of treatment costs must be done considering the following factors

1. Actual operating cost of CETP
2. Depreciation of building, machinery and equipment of the CETP
3. Maintenance cost present and anticipated
4. Associated cost factor, for sludge disposal etc.
5. Likely changes in government policies.
A suitable method must be devised to share the operating cost among the member tanners.

8.7.3.4 Cost sharing among tanners

The generally adopted principle is that the CETP operation charges are distributed among tanner members proportionate to their actual contribution to pollution load of the CETP. However, in many cases, it is very difficult to arrive at a suitable cost sharing structure agreeable to all members of the tannery cluster. It may be stated that cost sharing is to be done based on the following from an individual member:

1. Hydraulic load - effluent flow rate from the individual tannery

2. Pollution Load - pollution load as being calculated in terms of values reported for various parameters.

In developed countries these two factors are being measured regularly and cost sharing is done based on certain formula. Due to the present conditions existing in our country, it may not be possible to arrive at a similar arrangement now. While determination of pollution load is often difficult owing to the absence of continuous monitoring instruments in individual tannery outlets, the first step has to be to calculate at least the hydraulic load and then to devise a formula based on it to distribute the CETP operation cost among the tanners.

8.7.3.5 Measurement of flow

Following are methods generally used to calculate the hydraulic load from individual tannery:
1. Measuring the process water consumption: While this method is relatively simple, it has got the disadvantage due to possibility of dispute owing to tampering of water meters, different level of water absorption in each process and multiple process water sources viz., ground water, corporation water, tanker water.

2. Fixing flow measuring systems.

Normally the flow rates are measured by installing V notches or mechanical devices. Fixing of V notches in small-scale industries, where the flow rate is intermittent and varying is not a practical solution. For the same reason, flow meters working on level difference are also not much preferred. While several other types of flow meters like magnetic, venturi and electromagnetic are available, a type is yet to be standardised for CETPs.

8.7.3.6 Financial auditing

In operation of CETPs, effective financial auditing is a must. Most of the CETP management do not know where and in which manner the money sanctioned is spent. Often, requirement of finance in a CETP is made as technical requirement and owing to this aspect, the CETP management, which basically regards itself as non technical (at least in environmental engineering), does not monitor the matter beyond that point. On the other hand, some CETP management, which regard CETP as a non productive area where expenditure should be kept as low as possible, do not sanction even the basic requirements (most of them come under preventive maintenance) resulting in serious problems in CETP performance and life of equipment. Anyhow, there cannot be any
difference of opinion on the statement that the operation cost of CETP should be kept minimum and the following arrangement is accordingly suggested.

To begin with, the company should fix standards of performance for the CETP units and for achieving those standards, the maximum level of expenditure under different heads considered reasonable should be specified. Every CETP company should constitute a finance committee to review the expenditure of CETP operation. The committee may include or get guidance from a technical expert also. This committee may meet at least once in a month to review the expenditure incurred in the previous month. The audit may be on mainly the following points:

i. reviewing expenditure made on operational cost against prescribed standard figures.

ii. review the type and cause of any new expenditure during the review period

iii. apportioning expenditures in treatment such as treatment, maintenance, sludge disposal, etc.

iv. scrutinising store's inventory and recommending purchase and

v. critical assessment of manpower utilisation and productivity.
Reviewing expenditure made pre-supposes obtaining all data relevant to the treatment. This evaluation should be done on each of the treatment steps. This may be difficult as the efficiency of chemical and biological treatments vary depending on various factors such as fluctuations in quantity and characteristics of effluent, microbial population, etc. However, one can very well fix the limiting points and the sanctity of judgement depends on one's reasons and experience. Any new problem reported from the CETP should be analysed carefully. The cause of the same should be found and remedial measure taken without delay. For example, if the problem is in some equipment apart from repairing equipment, the cause should be identified and measures taken to ensure that such problem did not recur.

A clear-cut policy of vendor development should be evolved and reviewed in meetings. What to keep in store and what can be purchased as per demand, etc. should be identified and action taken accordingly. Perhaps, absence of a small screw in store may lead to a major breakdown. Purchase of chemicals should be arranged such that at no time, the CETP should be without sufficient chemicals. Also the payment for chemicals should be in accordance with the quality of chemical.

The committee can decide on policy matters of the company also wherever cost issues are involved. Ways and means to get the best utilisation of facilities provided should be one of the prime concerns of the committee. Sometimes, this can be a source of revenue for the company. For example, a CETP laboratory equipped with facilities for almost all normal parameters can accept samples from other industries and individual ETPs also. The basic equipment backup required for converting the laboratory in a CETP as a public utility service laboratory is practically nil, except for higher quantity of chemicals and manpower [if
the number of samples received becomes high. The samples can be tested at a reasonable charge and the income generated may be enough to meet the expenses of the laboratory.

8.7.3.7 Repayment of loans

CETPs for tanneries in India generally are funded by way of taking loans to a substantial extent from financial institutions and banks. Repayment of such loan must be an integral part of planning strategy of a CETP. It will be advantageous to have a separate account for the loan repayment and it should be made the duty of the CETP administrator to keep requisite funds in it always. Also, some extra funds may be kept in this account to ensure uninterrupted repayments in case of any contingency like shutdown, etc.

8.8 LIAISON WITH STATUTORY BODIES FOR CONCESSIONS

It is the duty of the administrator of the CETP to ensure that the CETP operation cost is kept at the minimum. Consistent with efficient performance of the plant, all possible sources of reducing operation cost should be explored continuously. Often, the biggest cost factor in CETP operation is power consumption. For instance, in the State of Tamil Nadu, power is very costly and the charge paid by CETP with HT connection comes to around Rs.3/- per unit. Another area is the reduction of taxes for chemicals being consumed by the CETP. This matter may be pursued and if it works out, it will reduce the burden on CETP operation cost.

CETP companies may approach the government for land for disposal of solid wastes free or at a subsidised rate. It may be noted that nearly half of the treatment cost in many developed countries is accounted
for by sludge disposal. Also, if common disposal grounds are received from these will reduce the cost of sludge disposal to a great extent. For investments required in a CETP, it may be possible to get soft loans or low interest loan from many financial institutions. It is the duty of the administrator of CETP to explore these possibilities.

8.9 COMPARATIVE ANALYSIS OF SELECTED CETPs

A comparative analysis of seven operating CETPs is made taking into account the design capacity of CETPs, average flow and cost of treatment. For the cost of treatment the financial cost towards the capital investment depreciation, consumables such as power, chemical and laboratory services, cost of manpower input, repairs and maintenance, sludge dewatering and handling and other important components like consents and licence are taken into account. The consolidated details are given in Table 8.1. The cost towards the disposal of sludge is not taken into account in the absence of any specific guideline or procedure practised in the field. The main factor responsible for higher operation cost in two CETPs (Melvisharam and Pernambut) is the low utilisation of installed capacity. Melvisharam CETP is operating at about 25% of rated capacity and Pernambut CETP is operating at less than 50% of rated capacity. The lower cost of operation in Vaniyambadi and Ranipur CETP is due to anaerobic treatment before aerobic treatment. Anaerobic treatment reduces pollution load by about 35%. The higher cost at Pallavaram CETP is due to the energy intensive technology adopted here. This was necessitated by locational factors due to shortage of land.

Effective and efficient management is essential for cost effective operation of a CETP. At the early stages of operation of a CETP many problems do arise. Inadequate appreciation of the importance of the CETP
Table 8.1

Cost of treatment in the CETPs - the economics

<table>
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<th>Name of CETP</th>
<th>Designed capacity m³/day</th>
<th>Average daily flow m³/day</th>
<th>Average Monthly flow rate in m³</th>
<th>Monthly cost (Rs.)</th>
<th>Cost per cubic metre of flow (Rs.)</th>
<th>Cost per Kg. Of BOD removed (Rs.)</th>
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<td>Pernambut</td>
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<td>12780</td>
<td>1,099,755</td>
<td>86.05</td>
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and the resultant unacceptable behaviour of member tanners, particularly in conforming to the code of conduct, result in avoidable cost escalation. Constant education, training and raising awareness of tanners are a few measures necessary to make the tanners of the region realise the critical importance of efficient operation of the CETPs.