9. SUMMARY

- The tanning sector is the basic skeleton on which the entire leather industry depends and it is also one of the largest polluters. The inherent nature of the tanning process is such that large quantities of water are consumed. Tiruchirappalli is one of the active centres of Tanning industries in Tamilnadu.

- A survey on the types of effluent treatment plants performing in different tanneries was undertaken and their relative advantages and disadvantages were studied.

- Three major treatment plant designs were analyzed by surveying and studying the thirteen effluent treatment plants. They were: 1. Two stage Aerobic system with Tertiary Treatment (TSASTT), 2. Two Stage Aerobic System with Krofta (TSASK) and 3. Two Stage Aerobic systems with Common Settling tank (TSASCST).

- Based on the study of the functional performance, it was concluded that plants having two stage Aerobic systems with Tertiary Treatment are more mechanized and efficient when compared to the other two systems. The ETP namely TSASTT and TSASK were more suitable to treat effluent from tanneries processing five tonnes of skins and hides per day.

- The characteristics of tannery effluent of Tiruchirappalli district were also studied for a period of twelve months from January 2008 to December 2008. Tannery effluent samples were collected from the discharge point.
where in effluent from all the stages of processing units were released together.

- Physicochemical characteristics of the tannery effluent were analyzed following standard hydrographical methods (APHA, 1989).

- Results of the survey showed that tannery effluent was grey coloured with a disagreeable odour, acidic in pH, with high organic and inorganic load indicating high EC, BOD, COD, TSS, TDS, Total hardness, calcium, magnesium, sodium, chloride, sulphate and low level of the heavy metal, chromium.

- Biological characteristics included total heterotrophic bacterial population. The average total heterotrophic bacterial population in tannery effluent was $3.69 \times 10^7$ _cfu_/100ml.

- The impact of tannery effluent on the ground water quality of Sempattu village surrounded by cluster of tanneries was also assessed. Ground water samples collected from Sempattu area maintained higher values of TDS, TDS and oxygen demanding wastes. The Sempattu village was highly affected by the tannery effluent.

- The thorough analysis of ground water quality in Sempattu revealed that physicochemical parameters were not within the standards for safe drinking water prescribed by Indian Bureau of Standards (1991).

- The present research work also evaluated the performance of the ETP of a chosen tannery. The treatment there involved three stages, namely Primary, secondary and tertiary treatment.
The percentage of efficiency achieved at the end of tertiary treatment for parameters like TSS, TDS, Chlorides, Oil and grease, COD and BOD were 81.2%, 0.36%, 0.86%, 100%, 87.6% and 92.8% respectively. Seasonal changes were observed and the maximum reduction in the levels of BOD and COD was observed during the summer season.

Twelve species of fungi were isolated from the tannery effluent for a period of one year, from January 2008 to December 2008.

Fungal population studies revealed higher biodiversity, where in the Index of Dominance was inversely proportional to Index of General Diversity.

Bioremediation using fungi like Aspergillus niger and Aspergillus terreus individually and in combination (mixed culture of the above 2 fungi) was carried out to degrade the tannery effluent.

Biodegradation of tannery effluent was found to change pH from acidic to neutral, reduction of BOD, COD, TSS and TDS by over 50 to 80% thereby satisfying CPCB (1995) standards for effluent discharge, on to land for irrigation.

Biodegradation of 25% concentration tannery effluent by the individual and mixed fungi could bring down BOD, COD, TSS and TDS levels to CPCB standard for effluent discharge within 72 hrs. pH also could raise to neutral level.

Use of 100% effluent for biodegradation using fungi could not bring down the levels of BOD, COD, TSS and TDS to CPCB (1995) norms.
Studies were conducted to isolate and characterize bacteria capable of BOD, and COD reduction. Twenty five bacterial strains from tannery effluent were isolated and characterized for enzyme production.

From these twelve cultures which grew well in tannery effluent without additional carbon and nitrogen sources and produced enzymes were primarily selected and tested for their efficacy to reduce BOD and COD of tannery effluent.

Two strains namely *Bacillus cereus* ATTB 10 and *Pseudomonas aeruginosa* ATTB 27 were selected based on their efficiency to reduce the BOD and COD load of the tannery effluent.

Studies conducted on the reduction of BOD and COD using free bacterial cells indicated that the bacterial cells require at least 48h of incubation to reach significant levels of BOD and COD reduction. *Bacillus cereus* ATTB 10 was a better performer than *Pseudomonas aeruginosa* ATTB 27.

Immobilization of the bacteria in sodium alginate by gel entrapment technique was optimized. Four percent support concentration, 5mm bead size, 150mg of cells/100g of beads, yielded stable beads with maximal activity for the reduction of BOD and COD of tannery effluent.

Tannery effluent treatment in column reactor in batch process yielded a maximum BOD reduction of 77% by immobilized *Bacillus cereus* ATTB 10 at 12cm bed height after a contact time of 24 h. For this period the percentage reduction of BOD level was 67 for *Pseudomonas aeruginosa* ATTB 27.
- Tannery effluent treatment using immobilized bacteria in column reactor in continuous process also exhibited the superior ability of *Bacillus cereus* ATTB10 to reduce BOD and COD maximally.

- Comparisons were made between free cell treatment and immobilized cell treatment in batch process and continuous process, and it was clear that continuous treatment of tannery effluent using immobilized cells was advantageous and time saving compared to other methods of treatment.

- The need for installing a bioreactor ensemble as an additional effluent treatment module for tanneries has been emphasized.