INTRODUCTION

Tanning industries in India are classified as high polluting and growth oriented industries. There are about 3000 tanneries in India (Sekaran et al. 1999). According to Buljan and Sahasranaman (1999), the tanning operations worldwide have used almost 4 million tonnes of various chemicals and water produced possibly over 3000 m.cubic of waste water and 8 million tonnes of solid waste (sludge). Tannery waste waters contain high amount of proteins, BOD, chloride, hexavalent and trivalent chromium, nitrogen, phosphorus, sulphate and sulphides as inorganic constituents present in significant amount (Manivasakam, 1997). Due to indiscriminate discharges of treated and untreated tannery waste into land and water bodies get contaminated. This waste water when discharged into water course will affect physical, chemical and biological characteristics of ground water and will deplete the dissolved oxygen, High pH, excessive alkality, suspended solids and sulphides (Gokulakrishnan 2004).

According to Covington (2000) new processing technologies are developed to meet the standards for effluent discharge. Further biological treatment processes are cost effective method for hazardous substance disposal (Ajbar 2001). The most reliable way seems to be the biological treatment in which microorganisms serve as efficient detoxifiers of pollutants (Saravanan et al. 1999) as microorganisms degrade organic contaminants as they use it for their growth and reproduction. The microorganisms obtain energy by catalyzing energy producing chemical reactions and this energy is used in the production of new cells (Goudar and Subramanian, 1996). According to Emmanuel (1997), nitrogen and phosphorous are the prime nutrients required for the biological reaction which are present in the ef-

Key words: Tannery effluent, Biodegradation, Cell suspension method, Pseudomonas putida.

ABSTRACT

Tannery effluent samples rich in nutrient were collected from Ranipet, North Arcot District, Tamilnadu and analyzed for the physico-chemical parameters such as colour, pH, TDS, TSS, Chloride, Sulphide, Sulphate, Phosphorus and Nitrogen. The results showed that the above parameters exceeded the permissible limits prescribed by CPCB(1995). Biodegradation involves the use of microorganisms to degrade environmental contaminants, as microorganisms requires nitrogen and phosphorus as primary nutrients to degrade toxic compounds. In the present study Pseudomonas putida is used in biodegradation of tannery effluent and the results are discussed.

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Biodegradation of nutrient rich tannery effluent using biotreated effluent.

The viability of *Pseudomonas putida* from pure culture was maintained by regular subcultures on the nutrient agar slant to have the stock throughout the year. *Pseudomonas putida* is a unique soil microorganism which can adversely effects of organic solvents, such as toluene and poly aromatic hydrocarbon (PAH’S). *P. putida* was able to degrade the compounds other than phenol, present in the industrial waste water (Gonzalez et al. 2001). Bacterial chromate reductase can convert soluble and toxic chromate to the insoluble and less toxic Cr III can be reduced by *Pseudomonas putida* (MTCC 451).

For the present study, the tannery effluent was collected from a tannery in Ranipet, Tamilnadu, which has an industrial treatment plant. The effluent samples were collected from initial and final discharge points.

The pure culture of *Pseudomonas putida* (MTCC 2445) was obtained from the Institute of Microbial Technology, Chandigarh, India.

The physico-chemical parameters such as pH, EC, colour, COD, BOD, TS, TDS, Sulphide, Chloride, Sulphate, Phosphorous and Nitrogen of the effluents were analyzed following the Standard Methods of APHA (1989).

### MASS Culture of *Pseudomonas putida*

The viability of *Pseudomonas putida* from pure culture was maintained by regular subcultures on the nutrient agar slant to have the stock throughout the year. *Pseudomonas putida* was inoculated in the nutrient agar medium (Nwachukwu et al. 2001), the pH was adjusted at 7.4 ± 2°C, for mass culture the inoculum was taken from the nutrient agar medium and inoculated in 200mL nutrient broth in flask. The flasks were kept in orbital shaker at 180 rpm for 24hrs. The cell number was calculated using haemocytometer before subjecting it for experimental studies.

### Biodegradation of Tannery Effluent Using Cell Suspension Methods

400mL of tannery effluent (both untreated and industrial treated) were taken in 500mL autoclaved serum bottles. To this *Pseudomonas putida* was added at a cell population of (10-4 cells/mL). Controls were in abiotic medium with 400mL of untreated and industrial treated effluent. The experiments were conducted at 30°C ± 2 at 180 rpm. The physico-chemical parameters were studied on 5th, 10th and 15th day of experiments.

### RESULTS AND DISCUSSION

Analysis of physico-chemical parameters in tannery effluent from untreated and industrial treated is shown in Table 1. The investigation reveals that the colour of the untreated effluent was black and industrial treated was greyish yellow and the odour was pungent in both the sample may be due to large amount of total dissolved solids and chromium (Jawahar et al. 1998). The pH of the untreated effluent and industrial treated was highly acidic (3.9 and 6.7) and did not meet the general standards recommended by CPCB (1995) which is due to sub process such as bathing and fat liquefying in which acetic acid and formic acid are used as the source for the acidic pH (Manivasakam 1997 and Mohamed 2002). The EC of tannery effluent and industrial treated effluent was 12222 µmhos/cm and 8633 µmhos/cm respectively high level of conductivity may be due to the presence of inorganic substances and salts (Jawahar et al. 1998).

BOD (5 days) of the untreated and industrial treated were 1019 mg/L and 705 mg/L respectively which is due to presence of organic matter and toxic compounds (Trivedy, 2002) while the COD was 4857 mg/L and 3112 mg/L, these results found to be higher than the prescribed limits of CPCB, 1995 indicating the highly polluting nature of the tannery effluent. TDS of the untreated and industrial treated was 11556 mg/L and 7496 mg/L respectively due to substantial contribution made by sodium chlorides used during the preservation of raw hide skins (Manivasakam 1997) high contents of TDS would produce undesirable taste, gastro intestinal irritation, corrosion or incrustation (Gokulakrishnan and Pandurangan 2004) and the TSS content of untreated was 1015 mg/L and 528 mg/L. Sulphide content of untreated and industrial treated was 906 mg/L and 508 mg/L. Sulphide is usually present in excess concentration its toxic to fish and other aquatic life (Manivasakam 1997). Chloride was 3419 ±471 mg/L and 2415 ±704 mg/L which make the water unsuitable for irrigation. Sulphate was found to be 2274 ±430 mg/L and 1387 ±445 mg/L which was found to be higher and impact hardness to the coke oven waste water and exceed the permissible limits of CPCB was found to be higher than the prescribed limits of CPCB, 1995 again increase the total dissolved solids and other organic solvents.

**Table 1. Physico-chemical Characteristics of tannery effluents**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Untreated effluent</th>
<th>Industrial treated effluent</th>
<th>Permissible limits of CPCB (1995) mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>Grey colour</td>
<td>Slightly grey</td>
<td>Odourless</td>
</tr>
<tr>
<td>Odour</td>
<td>Disagreable smell</td>
<td>Disagreable smell</td>
<td>Odourless</td>
</tr>
<tr>
<td>pH</td>
<td>3.90 ± 0.51</td>
<td>6.7 ± 0.42</td>
<td>5.5-9.0</td>
</tr>
<tr>
<td>EC (µmhos/cm)</td>
<td>12222 ±1119</td>
<td>8633±966</td>
<td>**</td>
</tr>
<tr>
<td>TSS (mg/L)</td>
<td>1015 ±115</td>
<td>528 ±134</td>
<td>200</td>
</tr>
<tr>
<td>TDS (mg/L)</td>
<td>11556 ±899</td>
<td>7496 ±794</td>
<td>2100</td>
</tr>
<tr>
<td>COD (mg/L)</td>
<td>4857 ±563</td>
<td>312±108</td>
<td>250</td>
</tr>
<tr>
<td>BOD (mg/L)</td>
<td>3101 ±163</td>
<td>705 ±148</td>
<td>100</td>
</tr>
<tr>
<td>Sulphide (mg/L)</td>
<td>906 ±119</td>
<td>508 ±119</td>
<td>**</td>
</tr>
<tr>
<td>Chloride (mg/L)</td>
<td>3419 ±471</td>
<td>2415 ±704</td>
<td>650</td>
</tr>
<tr>
<td>Sulphate (mg/L)</td>
<td>2274 ±430</td>
<td>1387 ±445</td>
<td>400</td>
</tr>
<tr>
<td>Phosphorous (mg/L)</td>
<td>9.2 ± 2.7</td>
<td>7.2 ± 3.3</td>
<td>0.4-0.6</td>
</tr>
<tr>
<td>Nitrogen (mg/L)</td>
<td>61 ± 10</td>
<td>30.3 ± 10.9</td>
<td>0.0-0.02</td>
</tr>
<tr>
<td>Chlorium (mg/L)</td>
<td>39.1 ± 11.8</td>
<td>20.8 ± 6.3</td>
<td>2</td>
</tr>
</tbody>
</table>

*All efforts should be made to remove colour and unpleasant odour as far as possible.
**Permissible limit should be placed as Nil or agreeable.

*Pseudomonas putida* were used to biodegrade as they degrade organic contaminants for their growth and reproduction (Park et al. 2000). In addition the microorganisms requires nitrogen and phosphorus as primary nutrients, the microorganisms obtain energy by catalyzing energy producing chemical reaction and this energy is used in the production of new cells (Goudar and Subramaniam, 1996). The results showed that both untreated and industrial treated effluent has been found to contain these nutrients, practically no nutrient addition is required for microbial growth (Emmanuel, 1997) addition of phosphorus as phosphate buffer and nitrogen as NH4+ again increase the total dissolved solids and other organic solvents.

Culture of *Pseudomonas putida* were suspended in 100% untreated and industrial treated effluent for biodegradation. The biotreated effluents (untreated and industrial treated effluent) were analyzed for physico-chemical parameters at 5th, 10th, &15th day. According to of Ghosh et al. 2002, *Pseudomonas putida* was used to reduce colour as it is known to produce hydrogen peroxide, a strong decolorizing agent. These colour reduction from the results satisfy the CPCB (1995) prescribed standards for effluent discharge into land surface waters and irrigation. While Park et al. 2003 has demonstrated that *P. putida* KP-T202 could degrade TNT at various pH.
Biodegradation of nutrient rich tannery effluent using Pseudomonas putida as biograners in the tannery effluent decreased the parameters like colour, odour, TDS, sulphide and chloride which help as in reduction of organic pollutants.

REFERENCES


