CHAPTER 6

COSTING AND ECONOMICS FOR EFFLUENT TREATMENT AND RECOVERY OF VALUE ADDED PRODUCT

6.1 COST OF CHEMICALS FOR ONE LITRE OF MEDIUM

<table>
<thead>
<tr>
<th>Components</th>
<th>Required quantity (Kg)</th>
<th>Cost (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose</td>
<td>0.2</td>
<td>16.75</td>
</tr>
<tr>
<td>B. Peptone</td>
<td>0.02</td>
<td>4.60</td>
</tr>
<tr>
<td>Yeast extract</td>
<td>0.01</td>
<td>5.40</td>
</tr>
<tr>
<td>Sodium chloride</td>
<td>0.005</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Raw material cost = 27.00 Rs

Total raw material cost (50%) = 27.00 Rs
Utility cost (30%) = 16.20 Rs
Labor cost (20%) = 10.80 Rs
Amount of enzyme (crude) produced = 144 nmoles/g yeast
Amount produced = 25 g/litre of medium

\[ \text{: Amount of enzyme (crude)} \]
\[ \text{produced} = 3600 \text{ nmoles/litre} \]
\[ = 1.908 \times 10^8 \text{ ng/litre} \]
\[ = 0.01908 \text{ g} \]
6.2 Getting VAP from the metal removal plant

In azeotropic mixture from metal removal operation (at 78.15°C)

Ethanol = 10.57%
Water = 89.43%

Assume that 10000 litres per day of ethanol is available for recovery for use in distillation column.

In distillation the top will have = 2500 litres of water + 252.7 litres of ethanol
The bottom will have = 7247.3 litres of ethanol for reuse in metal removal Plant

2500 litres + 252.7 litres of ethanol can be used either for the production of biogas or for biomass production as cattle field.

6.3 BIOGAS PRODUCTION

Carbon in 252.2 litres of ethanol = 201.76 Kg x 24 = 105.3 Kg

1 Kg of carbon as COD gives 0.35 m³ CH₄ (Tebbutt, 1983)
105.3 Kg carbon = 36.8 m³ CH₄
1 m³ CH₄ = 2830 cals
36.8 m³ = 1.03 x 10² Kcal
6.53 Kcal = 1 Kg butane in LPG
104.5 Kcal = 16 Kg (1 cylinder)
104.5 Kcal = 160 Rs (approximately)
1 Kcal = 160
104.5 = 1.55 Rs/Kcal
Per year 1.03 x 10² K.Cal from CH₄ x 300 days/year
Per year = 30900 Kcal
Return on investment = 30900 x 1.53
= 47277 Rs
= 1100 US $/annum for a plant handling
2500 litres of water + 252.7 litres of ethanol
as effluent.

6.4 BIOMASS FOR CATTLE FIELD

Yeast grown for cattle field has 252.7 litres of ethanol + 2500 litres of water

i.e. = \[
\frac{252.7 \times 1000 \times 0.8}{1000} = \frac{201.6 \times 24}{46} = 105.3 \text{ Kg of carbon}
\]
All these carbon are converted to biomass.
Per mole of yeast has $C_{0.52} + O_{0.33} + N_{0.082} + H_{0.071}$ (Hagström, 1973)
It has 47% of carbon

Ethanol 105.3 Kg carbon/day x 300 days/year

\[
\begin{align*}
105.3 \times 300 & = 31590 \text{ Kg carbon} \\
31590 & = 67212 \text{ Kg of yeast/year} \\
0.47 & \\
\end{align*}
\]

Cost of cattle feed = 5.50 Rs/Kg (based on inquiry)
Biomass as 10% of cattle feed

\[
\begin{align*}
\text{Cost} & = 550 \text{ Rs/ton} \\
i.e. & = 67.212 \times 550 \\
& = 36967 \text{ Rs} \\
& = 860 \text{ US } \$
\end{align*}
\]

Therefore from 2500 litres of water and 252.7 litres of ethanol

\[
\begin{align*}
\text{Biogas gives} & = 1100 \text{ US } \$/annum \\
\text{Biomass gives} & = 860 \text{ US } \$/annum
\end{align*}
\]

Therefore, the return on investment in the case of biogas production is higher than in biomass production per annum.