

PROCESS ECONOMICS

COST OF EQUIPMENT :

The following includes the following equipments

1. Distillation columns – 2
2. Condensers – 3
3. Recoilless – 2
4. Crystallizes – 2
5. Centrifuges – 2
6. reactors – 1
7. Heat Exchangers – 3

Cost of Distillation columns:

Height = 17.5 m

Diameter = 1.411m

$N_c = 35$

Cost of trays = $35 * 450\$ = 35 * 450 * 40$ Rs.

= Rs. 630000

Cost of vessel = $8.5 * 1000$ pounds

= Rs. 510000

∴ Approximate cost of distillation column = Rs. $1 * 10^6$

∴ Cost of 2 Distillation columns = Rs. $2 * 10^6$

Cost of condensers and reboilers:

$$A = 42.55 \text{ m}^2$$

$$P_d = 1 \text{ atm.} \quad \text{Cost} = \text{Rs. } 670000$$

$$\begin{aligned} \therefore \text{Total cost} &= 5 * 670000 \\ &= \text{Rs. } 3.35 * 10^6. \end{aligned}$$

Cost of heat exchangers:

$$\text{Total cost} = 3 * 10 * 1000 * 60 = \text{Rs. } 1.8 * 10^6.$$

Cost of reactor:

$$\text{Volume (approx.)} = 20 \text{ m}^3. = 5580 \text{ Gallons.}$$

$$\text{Cost} = \text{Rs. } 3.2 * 10^6.$$

Cost of crystallizers:

$$\begin{aligned} \text{Cost} &= (8 * 10^4 * 40) + (4 * 10^4 * 40) \\ &= \text{Rs. } 4.8 * 10^6. \end{aligned}$$

Cost of centrifuges:

$$\begin{aligned} \text{Cost} &= (1.0 * 10^5 * 40) + (0.5 * 10^5 * 40) \\ &= \text{Rs. } 6.0 * 10^6. \end{aligned}$$

Total equipment cost = Σ component costs * cost index * other costs

$$= 3.3 * 10^7 * 1.2 * 1.2$$

$$= \text{Rs. } 4.752 * 10^7$$

Fixed Capital Investments = (4.752 x 10⁷ / 0.3)

$$= \text{Rs. } 1.584 * 10^8.$$

DETAILED COST ANALYSIS

I. Direct Costs :

(A) Equipment + Installation + Instrumentation + Piping +
Electrical + Insulation + Painting.

$$(1) \text{ Purchased equipment cost} = 0.3 * 1.584 * 10^8 \\ = \text{Rs. } 4.752 * 10^7.$$

$$(2) \text{ Installation, including insulation and painting} \\ = 0.3 * 4.752 * 10^7 \\ = \text{Rs. } 1.663 * 10^7.$$

$$(3) \text{ Instrumentation and controls} = 0.1 * 4.752 * 10^7 \\ = \text{Rs. } 4.752 * 10^6.$$

$$(4) \text{ Piping} = 0.2 * 4.752 * 10^7 \\ = \text{Rs. } 9.504 * 10^6.$$

$$(5) \text{ Electrical costs} = 0.15 * 4.752 * 10^7 \\ = \text{Rs. } 7.128 * 10^6.$$

$$(B) \text{ Building, process and auxillary} \\ = 0.3 * 4.752 * 10^7 \\ = \text{Rs. } 1.4256 * 10^7.$$

$$(C) \text{ Service facilities and yard improvements} \\ = 0.5 * 4.752 * 10^7 \\ = \text{Rs. } 2.376 * 10^7.$$

$$(D) \text{ Land} = 0.04 * 4.752 * 10^7 \\ = \text{Rs. } 1900800$$

$$\text{Direct costs} = A + B + C + D \\ = \text{Rs. } 1.2545 * 10^8.$$

II. Indirect costs

(A) Engineering and supervision = $0.1 * 1.2545 * 10^8$.
= Rs. $1.2545 * 10^7$.

(B) Construction expenses and supervision
= $0.10 * 1.2545 * 10^8$.
= Rs. $1.2545 * 10^7$

(C) Contingency costs = $0.1 * 1.584 * 10^8$.
= Rs. $1.584 * 10^7$

Indirect costs = A + B + C
= Rs. $4.093 * 10^7$

III. Fixed Capital Investments

= Direct + Indirect costs
= Rs. $1.664 * 10^8$.

IV. Working Capital

= $0.10 * 1.664 * 10^8$.
= Rs. $1.664 * 10^7$

V. Total Capital Investment

= Fixed + Capital Investment.
= Rs. $1.83 * 10^8$.

Total product cost = Rs. $2.7 * 10^8$.

I. Manufacturing Cost:

(A) Direct production costs

$$\begin{aligned}(1) \text{ Raw materials} &= 0.2 * 2.7 * 10^8 \\ &= \text{Rs. } 5.4 * 10^7.\end{aligned}$$

$$\begin{aligned}(2) \text{ Operating labour} &= 0.1 * 2.7 * 10^8 \\ &= \text{Rs. } 2.7 * 10^7.\end{aligned}$$

$$\begin{aligned}(3) \text{ Direct supervisory and electrical labour} & \\ &= 0.1 * 2.7 * 10^8 \\ &= \text{Rs. } 2.7 * 10^7.\end{aligned}$$

$$\begin{aligned}(4) \text{ Utilities} &= 0.05 * 2.7 * 10^8 \\ &= \text{Rs. } 1.35 * 10^7.\end{aligned}$$

$$\begin{aligned}(5) \text{ Maintenance and repairs} & \\ &= 0.03 * 2.7 * 10^8 \\ &= \text{Rs. } 8.1 * 10^6.\end{aligned}$$

$$\begin{aligned}(6) \text{ Operating supplies, laboratory charges and patents and royalties} & \\ &= 0.12 * 2.7 * 10^8 \\ &= \text{Rs. } 3.24 * 10^7.\end{aligned}$$

$$\begin{aligned}\text{Direct Production cost} &= \text{Sum Of (1), (2), (3), (4), (5) and (6)} \\ &= \text{Rs. } 1.62 * 10^8.\end{aligned}$$

(B). Fixed Charges

$$\begin{aligned}&= 0.1 * 2.7 * 10^8 \\ &= \text{Rs. } 2.7 * 10^7.\end{aligned}$$

(C) Plant overhead costs

$$= 0.05 \times 2.7 \times 10^8$$

$$= \text{Rs. } 1.35 \times 10^7$$

$$\text{Manufacturing cost} = A + B + C$$

$$= \text{Rs. } 2.025 \times 10^8$$

2. General Expenses

$$= 0.25 \times 2.7 \times 10^8$$

$$= \text{Rs. } 6.75 \times 10^7$$

3. Total product cost

$$= 2.025 \times 10^8 + 6.75 \times 10^7$$

$$= \text{Rs. } 2.7 \times 10^8$$

4. Current selling price

$$\text{Cost of xylenes} = \text{Rs. } 9/\text{kg}$$

$$\text{Total selling price per annum} = 35000 \times 10^3 \times 9$$

$$= \text{Rs. } 3.15 \times 10^8 / \text{annum.}$$

5. Gross earnings

$$= \text{Total selling price} - \text{Total product cost}$$

$$= \text{Rs. } 4.5 \times 10^7$$

6. Tax

$$= 0.3 \times 4.5 \times 10^7$$

$$= \text{Rs. } 1.35 \times 10^7$$

7. Net profits

$$= \text{Gross earnings} - \text{tax}$$

$$= \text{Rs. } 3.15 \times 10^7$$

8. Rate of return

$$\begin{aligned} &= (\text{Net profit} / \text{Fixed capital investment}) \\ &= (3.15 \times 10^7 / 1.584 \times 10^8) \\ &= 19.88\% \end{aligned}$$

Break even production : Let N kgs be the per annum production for breaking even.

Selling price = Fixed Charges + direct production costs

$$\begin{aligned} 9N &= 2.7 \times 10^7 + 1.62 \times 10^8 \\ \Rightarrow N &= 21 \text{ TPA.} \end{aligned}$$