

COST ESTIMATION

Cost of acetaldehyde plant of capacity **150 TPD** in 1971 is Rs. **7×10^8** .

Chemical Engineering Plant Cost Index:

Cost index in 1971 = 132

Cost index in 2002 = 402

Thus, Present cost of Plant = (original cost) * (present cost index)/(past cost index)

$$= (7 \times 10^8) * (402/132) = \text{Rs. } 21.3182 \times 10^8$$

i.e., Fixed Capital Cost (FCI) = Rs. 21.3182×10^8

Estimation of Capital Investment Cost:

I. **Direct Costs:** material and labor involved in actual installation of complete facility (70-85% of fixed-capital investment)

a) Equipment + installation + instrumentation + piping + electrical + insulation + Painting (50-60% of Fixed-capital investment)

1. **Purchased equipment cost (PEC):** (15-40% of Fixed-capital investment)

Consider purchased equipment cost = 25% of Fixed-capital investment

$$\text{i.e., PEC} = 25\% \text{ of } 21.3182 \times 10^8 = 0.25 * 21.3182 \times 10^8 = \text{Rs. } 5.32955 \times 10^8$$

2. **Installation, including insulation and painting:** (25-55% of purchased equipment cost.)

Consider the Installation cost = 40% of Purchased equipment cost

$$= 40\% \text{ of } 5.32955 \times 10^8 = 0.40 * 5.32955 \times 10^8 = \text{Rs. } 2.13182 \times 10^8$$

3. **Instrumentation and controls, installed:** (6-30% of Purchased equipment cost.)

Consider the installation cost = 15% of Purchased equipment cost

$$= 15\% \text{ of } 5.32955 \times 10^8 = 0.15 * 5.32955 \times 10^8 = \text{Rs. } 0.7994325 \times 10^8$$

4. **Piping installed:** (10-80% of Purchased equipment cost)

Consider the piping cost = 40% Purchased equipment cost

$$= 40\% \text{ of } 5.32955 * 10^8 = 0.40 * 5.32955 * 10^8$$

$$= \text{Rs. } 2.13182 * 10^8$$

5. **Electrical, installed:** (10-40% of Purchased equipment cost)

Consider Electrical cost = 25% of Purchased equipment cost

$$= 25\% \text{ of } 5.32955 * 10^8 = 0.25 * 5.32955 * 10^8 = \text{Rs. } 1.3323875 * 10^8$$

Hence total cost of (1+2+3+4+5) = $11.7250075 * 10^8$ Rs.---(54.99% of FCI)

B. Buildings, process and Auxiliary: (10-70% of Purchased equipment cost)

Consider Buildings, process and auxiliary cost = 40% of PEC

$$= 40\% \text{ of } 5.32955 * 10^8 = 0.40 * 5.32955 * 10^8 = \text{Rs. } 21.3182 * 10^8$$

C. Service facilities and yard improvement: (40-100% of Purchased equipment cost)

Consider the cost of service facilities and yard improvement = 62% of PEC

$$= 62\% \text{ of } 5.32955 * 10^8 = 0.62 * 5.32955 * 10^8 = \text{Rs. } 3.304321 * 10^8$$

D. Land: (1-2% of fixed capital investment or 4-8% of Purchased equipment cost)

Consider the cost of land = 5% of PEC = 5% of $5.32955 * 10^8 = 0.05 * 5.32955 * 10^8$

$$= \text{Rs. } 0.2664775 * 10^8$$

Thus, Direct cost = $\text{Rs. } 17.4276285 * 10^8$ ----- (81.75% of FCI)

II. Indirect costs: expenses which are not directly involved with material and labour of actual installation of complete facility (15-30% of Fixed-capital investment)

A. Engineering and Supervision: (5-30% of direct costs)

Consider the cost of engineering and supervision = 15% of Direct costs

i.e., cost of engineering and supervision = 15% of $17.4276285 * 10^8$

$$= 0.15 * 17.4276285 * 10^8 = \text{Rs. } 2.61414 * 10^8$$

B. Construction Expense and Contractor's fee: (6-30% of direct costs)

Consider the construction expense and contractor's fee = 10% of Direct costs

i.e., construction expense and contractor's fee = 14% of $17.4276285 * 10^8$

$$= 0.14 * 17.4276285 * 10^8 = \text{Rs. } 2.43986799 * 10^8$$

C. Contingency: (5-15% of Fixed-capital investment)

Consider the contingency cost = 10% of Fixed-capital investment

$$\begin{aligned} \text{i.e., Contingency cost} &= 10\% \text{ of } 17.4276285 * 10^8 = 0.10 * 17.4276285 * 10^8 \\ &= \text{Rs. } 1.74276 * 10^8 \end{aligned}$$

Thus, Indirect Costs = Rs. $6.796768 * 10^8$ --- (29.88% of FCI)

III. Fixed Capital Investment:

Fixed capital investment = Direct costs + Indirect costs

$$= (17.4276285 * 10^8) + (6.796768 * 10^8)$$

i.e., Fixed capital investment = Rs. $24.2243965 * 10^8$

IV. Working Capital: (10-20% of Fixed-capital investment)

Consider the Working Capital = 15% of Fixed-capital investment

$$\begin{aligned} \text{i.e., Working capital} &= 15\% \text{ of } 21.3182 * 10^8 = 0.15 * 21.3182 * 10^8 \\ &= \text{Rs. } 3.19773 * 10^8 \end{aligned}$$

V. Total Capital Investment (TCI):

Total capital investment = Fixed capital investment + Working capital

$$= (24.2243965 * 10^8) + (3.19773 * 10^8)$$

i.e., Total capital investment = Rs. $27.42212 * 10^8$

Estimation of Total Product cost:

I. Manufacturing Cost = Direct production cost + Fixed charges + Plant overhead cost.

A. Fixed Charges: (10-20% total product cost)

i. Depreciation: (depends on life period, salvage value and method of calculation-about 10% of FCI for machinery and equipment, and 2-3% for Building Value for Buildings)

Consider depreciation = 10% of FCI for machinery and equipment, and 3% for Building Value for Buildings)

$$\begin{aligned} \text{i.e., Depreciation} &= (0.10 * 21.3182 * 10^8) + (0.03 * 21.3182 * 10^8) = \\ &= \text{Rs. } 2.771366 * 10^8 \end{aligned}$$

ii. Local Taxes: (1-4% of fixed capital investment)

Consider the local taxes = 4% of fixed capital investment

$$\text{i.e. Local Taxes} = 0.04 * 21.3182 * 10^8 = \text{Rs. } 0.852728 * 10^8$$

iii. Insurances: (0.4-1% of fixed capital investment)

Consider the Insurance = 0.6% of fixed capital investment

$$\text{i.e. Insurance} = 0.006 * 21.3182 * 10^8 = \text{Rs. } 0.1279092 * 10^8$$

iv. Rent: (8-12% fixed capital investment)

Consider rent = 10% of fixed capital investment

$$\begin{aligned} &= 10\% \text{ of } 21.3182 * 10^8 \\ &= 0.10 * 21.3182 * 10^8 \end{aligned}$$

$$\text{Rent} = \text{Rs. } 2.13182 * 10^8$$

$$\text{Thus, Fixed Charges} = \text{Rs. } 5.8838232 * 10^8$$

B. Direct Production Cost:

Now we have Fixed charges = 10-20% of total product charges – (given)

Consider the Fixed charges = 15% of total product cost

- ⇒ Total product cost = fixed charges/15%
- ⇒ Total product cost = $5.8838232 * 10^8 / 15\%$
- ⇒ Total product cost = $5.8838232 * 10^8 / 0.15$
- ⇒ Total product cost (TPC) = $\text{Rs. } 39.225488 * 10^8$

i. Raw Materials: (10-50% of total product cost)

Consider the cost of raw materials = 30% of total product cost

⇒ Raw material cost = 30% of $39.225488 \times 10^8 = 0.30 \times 39.225488 \times 10^8$

⇒ Raw material cost = Rs. 11.767646×10^8

ii. Operating Labor (OL): (10-20% of total product cost)

Consider the cost of operating labor = 15% of total product cost

⇒ Operating labor cost = 15% of $39.225488 \times 10^8 = 0.12 \times 39.225488 \times 10^8$

⇒ Operating labor cost = Rs. 5.883823×10^8

iii. Direct Supervisory and Clerical Labor (DS & CL): (10-25% of OL)

Consider the cost for Direct supervisory and clerical labor = 12% of OL

⇒ Direct supervisory and clerical labor cost = 12% of 5.883823×10^8
 $= 0.12 \times 5.883823 \times 10^8$

⇒ Direct supervisory and clerical labor cost = Rs. 0.70606×10^8

iv. Utilities: (10-20% of total product cost)

Consider the cost of Utilities = 15% of total product cost

⇒ Utilities cost = 15% of $39.225488 \times 10^8 = 0.12 \times 39.225488 \times 10^8$

⇒ Utilities cost = Rs. 5.883823×10^8

v. Maintenance and repairs (M & R): (2-10% of fixed capital investment)

Consider the maintenance and repair cost = 5% of fixed capital investment

i.e. Maintenance and repair cost = $0.05 \times 21.3182 \times 10^8 = \text{Rs. } 1.06591 \times 10^8$

vi. Operating Supplies: (10-20% of M & R or 0.5-1% of FCI)

Consider the cost of Operating supplies = 15% of M & R

Operating supplies cost = 15% of $1.06591 \times 10^8 = 0.15 \times 1.06591 \times 10^8$

Operating supplies cost = Rs. 0.1598865×10^8

vii. Laboratory Charges: (10-20% of OL)

Consider the Laboratory charges = 15% of OL

Laboratory charges = 15% of $5.883823 \times 10^8 = 0.15 \times 5.883823 \times 10^8$

⇒ Laboratory charges = Rs. 0.023982975×10^8

viii. Patent and Royalties: (2-6% of total product cost)

Consider the cost of Patent and royalties = 5% of total product cost

$$\Rightarrow \text{Patent and Royalties} = 5\% \text{ of } 39.225488 \times 10^8 = 0.05 \times 39.225488 \times 10^8$$

$$\Rightarrow \text{Patent and Royalties cost} = \text{Rs. } 1.9612744 \times 10^8$$

Thus, Direct Production Cost = Rs. 35.10815288×10^8

C. Plant overhead Costs (50-70% of Operating labor, supervision, and maintenance or 5-15% of total product cost); includes for the following: general plant upkeep and overhead, payroll overhead, packaging, medical services, safety and protection, restaurants, recreation, salvage, laboratories, and storage facilities.

Consider the plant overhead cost = 60% of OL, DS & CL, and M & R

$$\text{Plant overhead cost} = 60\% \text{ of } ((5.883823 \times 10^8) + (0.70606 \times 10^8) + (1.60591 \times 10^8))$$

$$\text{Plant overhead cost} = 0.60 \times ((5.883823 \times 10^8) + (0.70606 \times 10^8) + (1.60591 \times 10^8))$$

$$\text{Plant overhead cost} = \text{Rs. } 7.655793 \times 10^8$$

Thus, Manufacture cost = Direct production cost + Fixed charges + Plant overhead costs.

$$\text{Manufacture cost} = 35.10815288 \times 10^8 + (5.8838232 \times 10^8) + 7.655793 \times 10^8$$

$$\text{Manufacture cost} = \text{Rs. } 48.647769 \times 10^8$$

II. General Expenses = Administrative costs + distribution and selling costs + research and development costs

A. Administrative costs:(40-60% of operating labor)

Consider the Administrative costs = 50% of operating labor

$$\Rightarrow \text{Administrative costs} = 0.5 \times 5.883823 \times 10^8$$

$$\Rightarrow \text{Administrative costs} = \text{Rs. } 2.9419115 \times 10^8$$

B. Distribution and Selling costs: (2-20% of total product cost); Includes costs for sales offices, salesmen, shipping, and advertising.

Consider the Distribution and selling costs = 10% of total product cost

$$\text{Distribution and selling costs} = 10\% \text{ of } 39.225488 \times 10^8$$

$$\Rightarrow \text{Distribution and selling costs} = 0.1 \times 39.225488 \times 10^8$$

$$\Rightarrow \text{Distribution and Selling costs} = \text{Rs. } 3.9225488 \times 10^8$$

C. Research and Development costs: (about 3% of total product cost)

Consider the Research and development costs = 3% of total product cost

$$\text{Research and Development costs} = 3\% \text{ of } 39.225488 \times 10^8$$

$$\Rightarrow \text{Research and development costs} = 0.03 * 39.225488 \times 10^8$$

$$\Rightarrow \text{Research and Development costs} = \text{Rs. } 1.17676 \times 10^8$$

$$\text{Thus, General Expenses} = \text{Rs. } 8.04122703 \times 10^8$$

III. Total Production cost = Manufacture cost + General Expenses

$$= (48.647769 \times 10^8) + (8.04122703 \times 10^8)$$

$$\text{Total production cost} = \text{Rs. } 56.6889893 \times 10^8$$

IV. Gross Earnings/Income:

Wholesale Selling Price of acetaldehyde per kg = £ 2.0

Let 1£ = Rs. 70.00

Hence Selling Price of acetaldehyde per kg = 2.0 * 70 = Rs. 140

Total Income = Selling price * Quantity of product manufactured

$$= 140 * (150 \times 10^3 / \text{day}) * (330 \text{ days/year})$$

$$\text{Total Income} = \text{Rs. } 69.3 \times 10^8$$

Gross income = Total Income – Total Production Cost

$$= (69.3 \times 10^8) - (56.6889893 \times 10^8)$$

$$\text{Gross Income} = \text{Rs. } 12.6110107 \times 10^8$$

Let the Tax rate be 45% (common)

Taxes = 45% of Gross income

$$= 45\% \text{ of } 12.6110107 \times 10^8 = 0.45 * 12.6110107 \times 10^8$$

$$\text{Taxes} = \text{Rs. } 5.674954815 \times 10^8$$

Net Profit = Gross income - Taxes = Gross income * (1 - Tax rate)

$$\text{Net profit} = 12.6110107 \times 10^8 * (1 - 0.4) = \text{Rs. } 6.9360558 \times 10^8$$

Rate of Return:

Rate of return = Net profit*100/Total Capital Investment

Rate of Return = $6.9360558 \times 10^8 / (27.42212 \times 10^8)$

Rate of Return = 0.2529 = 25.29%