

9. COST ESTIMATION

The capital investment for the 250TPD ammonium sulphate plant was found to be Rs310.30 crores in the year of .1993-94.

Chemical Engineering Plant Cost Index:

Cost index in 1994 = 368.1

Cost index in 2002 = 402

Thus, Present cost of Plant = (original cost) \times (present cost index)/(past cost index)
 $= 310.3 \times 10^7 (402/368.1) = 338.8 \times 10^7$

i.e., Fixed Capital Cost (FCI) = Rs 338.8×10^7

Estimation of Capital Investment Cost:

1. Direct Costs:

Material and labour 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

i.e., PEC = 25% of Rs $338.8 \times 10^7 = 0.25 \times 338.8 \times 10^7 = \text{Rs. } 84.7 \times 10^7$

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

Consider the Installation cost = 40% of Purchased equipment cost

$= 0.40 \times 84.7 \times 10^7 = \text{Rs. } 33.88 \times 10^7$

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

$$\begin{aligned}\text{Consider the installation cost} &= 15\% \text{ of Purchased equipment cost} \\ &= 0.15 \times 84.7 \times 10^7 = \text{Rs. } 12.7 \times 10^7\end{aligned}$$

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

$$\begin{aligned}\text{Consider the piping cost} &= 40\% \text{ Purchased equipment cost} \\ &= 0.40 \times 84.7 \times 10^7 = \text{Rs } 33.8 \times 10^7\end{aligned}$$

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

$$\begin{aligned}\text{Consider Electrical cost} &= 25\% \text{ of Purchased equipment cost} \\ &= 0.25 \times 84.7 \times 10^7 = \text{Rs. } 21.17 \times 10^7\end{aligned}$$

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

$$\begin{aligned}\text{Consider Buildings, process and auxiliary cost} &= 40\% \text{ of PEC} \\ &= 0.40 \times 84.7 \times 10^7 = \text{Rs } 33.8 \times 10^7\end{aligned}$$

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

$$\begin{aligned}\text{Consider the cost of service facilities and yard improvement} &= 50\% \text{ of PEC} \\ &= 0.50 \times 84.7 \times 10^7 \\ &= \text{Rs. } 43.7 \times 10^7\end{aligned}$$

D. Yard improvements: (10-15)% purchased equipment cost)

$$\begin{aligned}\text{considering } 12\% \text{ of PEC} &= 0.12 \times 84.7 \times 10^7 \\ &= \text{Rs } 10.4 \times 10^7\end{aligned}$$

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

$$\begin{aligned}\text{Consider the cost of land of 5\% PEC} &= 0.05 \times 84.7 \times 10^7 \\ &= \text{Rs. } 4.37 \times 10^7\end{aligned}$$

Thus, Direct cost = Rs.274.27×10⁷

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)

$$\begin{aligned}\text{Consider the cost of engineering and supervision} &= 10\% \text{ of Direct costs} \\ &= 0.1 \times 274.27 \times 10^7 = \text{Rs } 41.14 \times 10^7\end{aligned}$$

B. Construction Expense: (10% of direct costs)

$$\begin{aligned}\text{Consider the construction expense} &= 10\% \text{ of Direct costs} \\ &= 0.1 \times 274.27 \times 10^7 \\ &= \text{Rs. } 27.42 \times 10^7\end{aligned}$$

C. Contractor's fee: (2-7)% of direct cost.

Consider 4 % of direct cost.

$$\text{contractor's fee} = 0.04 \times 274.27 \times 10^7 = \text{Rs } 13.71 \times 10^7$$

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

$$\begin{aligned}\text{Consider the contingency cost} &= 10\% \text{ of direct cost} \\ &= 0.1 \times 274.27 \times 10^7 \\ &= \text{Rs. } 27.42 \times 10^7\end{aligned}$$

Thus, Indirect Costs = Rs.109.99×10⁷

III. Fixed Capital Investment:

$$\begin{aligned}\text{Fixed capital investment} &= \text{Direct costs} + \text{Indirect costs} \\ &= (\text{Rs.}274.27 \times 10^7) + (109.99 \times 10^7) \\ &= \text{Rs } 384.26 \times 10^7\end{aligned}$$

$$\text{Fixed capital investment} = \text{Rs. } 384.26 \times 10^7$$

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

$$\begin{aligned}\text{Consider the Working Capital} &= 15\% \text{ of Fixed-capital investment} \\ &= 0.15 \times 384.26 \times 10^7 \\ &= \text{Rs. } 57.63 \times 10^7\end{aligned}$$

V. Total Capital Investment (TCI):

$$\begin{aligned}\text{Total capital investment} &= \text{Fixed capital investment} + \text{Working capital} \\ &= (384.26 \times 10^7) + (57.63 \times 10^7) \\ &= \text{Rs. } 441.89 \times 10^7\end{aligned}$$

Estimation of Total Product cost:

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

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

- i. **Depreciation:** (depends on life period, salvage value and method of calculation-about 13% 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)

$$\begin{aligned}\text{i.e., Depreciation} &= (0.1 \times 384.89 \times 10^7 + .03 \times 33.8 \times 10^7) \\ &= \text{Rs. } 39.44 \times 10^7\end{aligned}$$

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

Consider the local taxes of 3% of fixed capital investment

$$\text{i.e. Local Taxes} = 0.03 \times 384.26 \times 10^7 = \text{Rs. } 15.37 \times 10^7$$

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

Consider the Insurance = 0.7% of fixed capital investment

$$\text{i.e. Insurance} = 0.007 \times 384.26 \times 10^7 = \text{Rs. } 2.306 \times 10^7$$

iv. Rent: (8-12% of value of rented land and buildings)

Consider rent = 10% of value of (rented land + buildings)

$$\text{Rent} = \text{Rs. } 0.06129 \times 10^7$$

Thus, Fixed Charges = depreciation + local taxes + insurance + rent Rs.

$$\text{Fixed Charges} = \text{Rs } 60.956 \times 10^7$$

B. Direct Production Cost: (about 60% of total product cost)

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

Consider the Fixed charges = 15% of total product cost

$$\text{Total product charge} = \text{fixed charges}/15\%$$

$$\text{Total product charge(TPC)} = \text{Rs. } 406.37 \times 10^7$$

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

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

$$\text{Raw material cost} = \text{Rs. } 121.911 \times 10^7$$

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

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

$$= 0.15 \times 406.37 \times 10^7$$

$$= \text{Rs } 60.95 \times 10^7$$

$$\text{Operating labour cost} = \text{Rs } 60.95 \times 10^7$$

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

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

$$\text{Direct supervisory and clerical labour cost} = 0.12 \times 60.95 \times 10^7$$

$$\text{Direct supervisory and clerical labour cost} = \text{Rs.} 9.14 \times 10^7$$

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

Consider the cost of Utilities = 12% of total product cost

$$= 0.12 \times 406.37 \times 10^7$$

$$\text{Utilities cost} = 48.7 \times 10^7$$

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

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

$$\text{Maintenance and repair cost} = 0.05 \times 60.956 \times 10^7$$

$$= \text{Rs.} 19.21 \times 10^7$$

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

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

$$\text{Operating supplies cost} = 0.15 \times 19.21 \times 10^7$$

$$\text{Operating supplies cost} = \text{Rs.} 2.88 \times 10^7$$

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

Consider the Laboratory charges = 14% of OL

$$\text{Laboratory charges} = 0.15 \times 60.95 \times 10^7$$

$$\text{Laboratory charges} = \text{Rs.} 9.14 \times 10^7$$

viii. **Patent and Royalties:** (0-6% of total product cost)

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

$$\text{Patent and Royalties} = 0.05 \times 406.95 \times 10^7$$

$$\text{Patent and Royalties cost} = \text{Rs.} 20.31 \times 10^7$$

$$\text{Thus, Direct Production Cost} = \text{Rs.} 252.68 \times 10^7$$

C. Plant overhead Costs (50-70% of Operating labour, 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

$$\text{Plant overhead cost} = 0.60 \times ((60.95 \times 10^7) + (9.14 \times 10^7) + (19.21 \times 10^7))$$

$$\text{Plant overhead cost} = \text{Rs. } 47.53 \times 10^7$$

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

$$\text{Manufacture cost} = (252.68 \times 10^7) + (60.956 \times 10^7) + (47.53 \times 10^7)$$

$$\text{Manufacture cost} = \text{Rs. } 359.16 \times 10^7$$

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

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

Consider the Administrative costs = 5% of operating labor

$$\text{Administrative costs} = 0.05 \times 60.95 \times 10^7$$

$$\text{Administrative costs} = \text{Rs. } 30.47 \times 10^7$$

A. 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

$$\text{Distribution and selling costs} = 0.10 \times 406.37 \times 10^7$$

$$= 40.63 \times 10^7$$

$$\text{Distribution and Selling costs} = \text{Rs. } 1.0519 \times 10^8$$

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

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

$$\text{Research and development costs} = 0.03 \times 406.37 \times 10^7$$

$$\text{Research and Development costs} = \text{Rs. } 12.09 \times 10^7$$

$$\text{Thus General Expenses} = 83.29 \times 10^7$$

IV. Total Product cost = Manufacture cost + General Expenses

$$= (83.29 \times 10^7) + (359.16310^7)$$

$$\text{Total product cost} = \text{Rs. } 8.1279 \times 10^8$$

V. Gross Earnings/Income:

Wholesale Selling price of ammonium sulphate per kg = Rs 115.50

Total Income = Selling price \times Quantity of product manufactured

$$= 115.50 \times (250 \text{ T/day}) \times (330 \text{ days/year})$$

$$\text{Total Income} = \text{Rs } 952.87 \times 10^7$$

Gross income = Total Income – Total Product Cost

$$= (. 952.87 \times 10^7 - 442.45 \times 10^7)$$

$$\text{Gross Income} = \text{Rs. } 510.42 \times 10^7$$

Let the Tax rate be 40% (common)

Taxes = 40% of Gross income

$$= 0.40 \times 510.42 \times 10^7 = 204.168 \times 10^7$$

$$\text{Taxes} = \text{Rs } 204.168 \times 10^7$$

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

$$\text{Net profit} = 510.42 \times 10^7 \times (1 - 0.4)$$

$$\text{Net profit} = \text{Rs } 306.252 \times 10^7$$

VI Rate of Return:

Rate of return = (Net profit/ Total Capital Investment) \times 100

$$\text{Rate of Return} = (306.252 \times 10^7 / 6.8213 \times 10^8) \times 100$$

$$\text{Rate of Return} = 60.04\%$$