

COST ESTIMATION AND ECONOMICS

An acceptable design must present a process that is capable of operating under conditions which will yield profit. Capital must be allocated for the direct plant expenses such as those for raw materials, labor and equipment. Besides direct expenses many other indirect expenses are also incurred e.g. administration, salaries, product distribution cost, cost for interplant communications.

A capital investment is required for any industrial process and determination of necessary investment for any process consists of fixed capital investment for physical equipment and facilities in the plant plus working capital which must be available to pay the salaries keep raw materials and products on the hand and handle other specified items required a direct cash outlay.

Thus in analysis of cost in industrial processes, capital investment cost, manufacturing costs and general expenses including income taxes must be taken into consideration. Here method chosen is the annual cost method because of the following advantages:

1. Effects of seasonal variations are smoothed out.
2. Plant on stream time or equipment operating factor is considered.
3. It permits more rapid calculation of operating cost at less than full capacity.
4. It provides a convenient way of considering infrequently occurring but large expenses such as annual turn around cost.

Cost of producing ethyl benzene per annum in 1965 = \$ 5.5×10^6

Chemical plant index for the year 1965 = 76.2

Chemical plant index for the year 2002 = 402

Therefore cost of plant in 2002 =

$$\begin{aligned} & \text{Cost in 1965} \times \left\{ \frac{\text{cost index in 2002}}{\text{cost index in 1965}} \right\} \\ & = 5.5 \times 10^6 \left(\frac{402}{76.2} \right) = \$ 29.016 \times 10^6 \end{aligned}$$

Or Rs. 143.63 crores (1\$ = 49.5 Rs)

Therefore fixed capital cost = FCC = Rs 143.63 crores

Total capital investment = TCI = FCC + Working capital

Working capital = 25% of TCI

Therefore working capital = Rs 179.54 crores

DISTRIBUTION OF CAPITAL COST

Direct cost	% Of FCC	Cost (crore of Rs)
Purchased equipments	20	28.726
Installation of equipment	9	12.9267
Instrumentation (installed)	3	4.3089
Piping	15	21.5445
Electrical (installed)	8	11.49
Buildings	12	17.2356
Yard improvements	2	2.8726
Service facilities	12	17.2356
Land	1	1.4363
	Total	117.7766

INDIRECT COST	% Of FCC	COST (crores of Rs.)
Engineering supervision	4	5.7452
Construction expense	6	8.6178
Contractors fee	3	4.3089
Contingency	5	7.1815
	Total	25.8534

ESTIMATION OF TOTAL PRODUCT COST

Let X be the total product cost

Distribution of total product cost

DIRECT PRODUCTION COST	COST (In Crores)
Raw materials (rm)	0.3X
Operating labor (ol)	0.15X
Supervision labor (sl)	0.025X
Utilities	0.15X
Maintenance and repairs (6% of FCC)	8.6178
Operating supplies	1.29267
Lab charges	0.0225X
Patent and royalties	0.05X
	Total = 9.91047 + 0.6975X

FIXED CHARGES	COST (In Crores)
Depreciation	14.363
Local taxes	4.3089
Insurance	1.4363
Plant overhead cost (15% {rm+ol+sl})	0.07125X
	Total = 20.1082 + 0.07125X

Fixed charge = 16% of TPC (let)

$$20.1082 + 0.07125X = 0.16X$$

$$X = 226.57 \text{ crores}$$

GENERAL EXPENSES

Administrative cost (25% ol)	0.0375X
Distribution & selling cost	0.15X
R & D cost	0.05X
	Total = 0.2375X

$$\begin{aligned} \text{Total product cost} &= \text{manufacturing cost} + \text{general expenses} \\ &= (30.1082 + 0.76875X) + 0.2375X \\ &= 30.1082 + 1.00625X \end{aligned}$$

$$X = 226.57 \text{ crores}$$

$$\text{Therefore general expenses} = 53.4 \text{ crores}$$

$$\text{Therefore manufacturing cost} = 204.2 \text{ crores or Direct production cost}$$

BREAK EVEN ANALYSIS

Break even point occurs when the total annual product cost equals the total annual sales. The total annual product cost is the sum of the fixed cost (including fixed charges, overhead and general expenses) and direct production cost for 'n' units per year. The total annual sale is the product of the number of units and the selling price per unit.

$$\text{Cost price of ethyl benzene per kg} = 226.57 \times 10^7 / 1 \times 10^7 = 226.57 \text{ or Rs. } 227$$

$$\text{Assuming a profit margin of 10\% so selling price of the product} = \text{Rs. } 250$$

$$\begin{aligned} \text{Gross annual earnings} &= \text{total annual sales} - \text{total annual product cost} \\ &= \text{Rs. } 23 \text{ crores} \end{aligned}$$

$$\begin{aligned} \text{Net annual earnings} &= \text{gross annual earnings} - \text{income tax} \\ &= 23 - 40\% \text{ of } 23 = 13.8 \text{ crores} \end{aligned}$$

$$\begin{aligned} \text{Pay back period} &= \frac{\text{total capital investment}}{\text{Net annual earnings}} \\ &= 179.54 / 13.8 = 13 \text{ years (approx)} \end{aligned}$$

$$\begin{aligned} \text{Rate of return} &= \frac{\text{net profit}}{\text{FCC}} \\ &= 13.8 / 143.63 = 9.6\% \end{aligned}$$