

## COST ESTIMATION AND ECONOMICS

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### 7.1 ESTIAMTION OF EQUIPMENT COST:

Marshall swift index for 2002 is 1048.

From Perry chemical engineering hand book, table 25-49 cost of the equipments with Marshall and Swift 1000

Equipment	Size	Unit	Cost \$000	n
Distillation column	4000	trays	3300	1.0
Shell and tube heat exchanger	9.3	m <sup>2</sup>	21.7	0.59
Jacketed Reactor	0.38	m <sup>3</sup>	9.3	0.53
Pressure vessel (flash drum)	3.8	m <sup>3</sup>	6.3	0.62
Centrifugal pump(no motor)	100	hp	4.4	0.67
Ac induction motor	10	hp	12.3	0.56

Cost estimated for the equipments for 150 TPD MEA production:

Number of distillation columns = 2

Number of heat exchangers = 5 (includes two condensers, two re-boilers and one heat exchanger).

Since boiling point difference is very high, hence is assumed to contain less number of trays. It is assumed that number of plates =15 in MEA tower.

Equipment	Number	Size	Unit	Cost \$000	n
Distillation column	1 <sup>st</sup>	9	trays	7425.00	1.0
	2 <sup>nd</sup>	15		12375.00	
Shell and tube heat exchanger	5	37.2	m <sup>2</sup>	245831.9	0.59
Jacketed Reactor	1	20	m <sup>3</sup>	75987.74	0.53
Pressure vessel (flash drum)	1	20	m <sup>3</sup>	17640.59	0.62
Centrifugal pump(nomotor)	4	5	hp	2364.95	0.67
Ac induction motor	4	5	hp	8343.12	0.56

Total cost of the equipments including 20% extra for any other accessories  
= Rs.24.837×10<sup>6</sup>.

## 7.2 ESTIMATION OF FIXED CAPITAL INVESTMENT:

Purchased equipment delivered, E	= Rs.24.837×10 <sup>6</sup>
Purchased equipment installation 39% E	= Rs.9.686×10 <sup>6</sup>
Instrumentation (installed), 28% E	= Rs.6.954×10 <sup>6</sup>
Electrical installed, 10% E	= Rs.2.4837×10 <sup>6</sup>
Piping (installed), 31% E	= Rs.7.69947×10 <sup>6</sup>
Buildings including services, 22% E	= Rs.5.464 ×10 <sup>6</sup>
Yard improvement, 10% E	= Rs.2.4837×10 <sup>6</sup>
Service facilities installed, 55% E	= Rs.13.66×10 <sup>6</sup>
Land, 6% E =1.49	

*TOTAL DIRECT PLANT COST, D* =Rs.74.76×10<sup>6</sup>

Engineering and Supervision, 32% of E =Rs.7.948×10<sup>6</sup>  
Construction expenses, 34 % of E =Rs.8.44×10<sup>6</sup>

*TOTAL DIRECT AND INDIRECT COST, D+I*=Rs.91.153×10<sup>6</sup>

Contractors fee's, 5% of (D+I) =Rs.4.557×10<sup>6</sup>  
Contingency, 10% of (D+I) =Rs.9.1153×10<sup>6</sup>  
Fixed capital investment =Rs.104.83×10<sup>6</sup>  
Working capital cost, (10-20)% of total capital investment =Rs.15.72×10<sup>6</sup>

**TOTAL CAPITAL INVESTMENT** = Rs.120.55×10<sup>6</sup>

## 7.3 ESTIMATION OF TOTAL PRODUCT COST:

### 7.31 MANUFACTURING COST

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 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)

i.e., Depreciation = Rs.10.483×10<sup>6</sup>

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

Consider the local taxes of 4% of fixed capital investment

i.e. Local Taxes = 0.04×104.83×10<sup>6</sup> = Rs.4.193×10<sup>6</sup>

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

Consider the Insurance = 0.6% of fixed capital investment

i.e. Insurance = 0.006×104.83×10<sup>6</sup> = Rs.628.98×10<sup>3</sup>

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

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

Rent = Rs.10.483 x10<sup>6</sup>

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

**Fixed Charges = Rs.21.594 x10<sup>6</sup>**

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

Let the total product cost be 'X'.

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

Consider the cost of raw materials = 25% of total product cost

Raw material cost = Rs.0.25×X

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

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

= Rs.0.15×X

**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 = Rs.0.018×X

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

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

$$\text{Utilities cost} = 0.15 \times X$$

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

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

$$\begin{aligned} \text{Maintenance and repair cost} &= 0.05 \times 104.83 \times 10^6 \\ &= \text{Rs.} 5.2415 \times 10^6 \end{aligned}$$

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

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

$$\text{Operating supplies cost} = \text{Rs.} 786.225 \times 10^3$$

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

Consider the Laboratory charges = 15% of OL

$$\text{Laboratory charges} = \text{Rs.} 0.0225 \times X$$

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

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

$$\text{Patent and Royalties cost} = \text{Rs.} 0.05 \times X$$

$$\text{Thus, Direct Production Cost} = \text{Rs.} (0.6405 \times X + 30.766 \times 10^6)$$

**B. 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

$$\text{Plant overhead cost} = \text{Rs.} 0.1 \times X + 3.145 \times 10^6$$

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

$$\text{Manufacture cost} = \text{Rs.}(0.7405 \times X + 30.766 \times 10^6)$$

### 7.32 GENERAL EXPENSES

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

$$\text{Administrative costs} = 0.075 \times X$$

**C. Distribution and Selling costs:** (2-20% of total product cost); I

This includes costs for sales offices, salesmen, shipping, and advertising.

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

$$\text{Distribution and selling costs} = 0.10 \times X$$

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

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

$$\text{Research and development costs} = 0.03 \times X$$

**Thus General Expenses = Rs.0.255X**

**Total Product cost** = Manufacture cost + General Expenses

$$= (0.7405 \times X + 30.766 \times 10^6) + (0.0255 \times X)$$

**Total product cost X = 891.76 × 10<sup>6</sup>**

### 7.4 GROSS EARNING/ INCOME

Wholesale Selling Price of Monoethanolamine per kg = Rs 4.0

Total Income = Selling price × Quantity of product manufactured

$$= 20 \times (150 \text{ Tons/day}) \times (325 \text{ days/year})$$

$$\text{Total Income} = \text{Rs.}975 \times 10^6$$

$$\text{Gross income} = \text{Total Income} - \text{Total Product Cost}$$

$$= (975 \times 10^6 - 891.76 \times 10^6)$$

$$\text{Gross Income} = \text{Rs.}83.24 \times 10^6$$

Let the Tax rate be 40% (common)

$$\text{Net Profit} = \text{Gross income} - \text{Taxes} = \text{Gross income} \times (1 - \text{Tax rate})$$

$$\text{Net profit} = 83.24 \times 10^6 \times (1 - 0.4)$$

$$\text{Net profit} = \text{Rs.}49.9 \times 10^6$$

**Rate of Return:**

$$\text{Rate of return} = (\text{Net profit} / \text{Total Capital Investment}) \times 100$$

$$\text{Rate of Return} = (49.9 \times 10^6 / (120.55 \times 10^6)) \times 100$$

$$\text{Rate of Return} = 41.43\%$$