

# COST ESTIMATION FOR THE PROPOSED

## ETHYLENE OXIDE PLANT

The capacity of the plant = 100 TPD

The operating hours per day = 24

Operation days per year = 300 days

The total production pr year = 30000 T

For an ethylene oxide plant installed in 1990 the total capital cost was \$ 50 million for a capacity of 50000 T/year.

Here the capacity is 30000 T/year. The total capital cost for this capacity can be calculated by applying the power factor applied to the plant capacity ratio.

$$C_n = C \cdot (R)^x$$

$C_n$  = The cost of plant with new capacity.

$C$  = The known cost of the plant with known capacity

$R$  = Plant capacity; here  $R = 30000/50000 = 0.6$

$(x)$  = The power factor = 0.78

Therefore  $C_n = \$ 33.5 \text{ million}$

M&S Cost index value for the year 1990 = **924**

M&S Cost index value for the year 1995 = **965**

(The calculations are done based on the year 1995)

Cost in 1995/cost in 1990 = Cost index in1995/ Cost index in 1990

Therefore cost in 1995 = **\$ 35 million**

Converting the cost into the Indian currency = **121 Crores.**

(\$1 = Rs 35/- in 1995). All the calculation given below are in Indian currency.

In 1995 the total capital cost of the ethylene oxide plant with capacity 30000T/year = **121 Crores.**

This cost calculated may vary according to the cost index value.

## **ESTIMATION OF CAPITAL INVESTMENT COST**

The percentages indicated in the following part are the various constituting the capital investment. These approximations are applicable to ordinary chemical processing plants. It should be realized that the values given could vary depending on many factors, such as plant location, type of process, complexity of instrumentation etc.

Fixed-capital investment (80-90% of the total capital investment)

$$= 0.85 * 121 = \mathbf{102.85 \text{ Crores.}}$$

Working-capital investment (20-10% of the total capital investment)

$$= 0.15 * 121 = \mathbf{18.15 \text{ Crores.}}$$

**Fixed capital investment = Direct Costs + Indirect Costs**

Direct costs

Material and labour involved in actual installation of complete facility. 70-85% of the Fixed-capital investment

Assumed as 77.5% of Fixed-capital investment.

$$= 0.775 * 102.85 = \mathbf{79.70 \text{ Crores.}}$$

Equipment + Installation + Instrumentation + Piping + Electrical + Insulation + Painting (50-60% Fixed-capital investment)

The assumed value is 55% of the Fixed-capital investment

$$= 0.55 * 79.70 = \mathbf{43.84 \text{ Crores.}}$$

Purchased equipment cost (15-40% of Fixed-capital investment)

The assumed value is 27.5% of the Fixed-capital investment

$$= \mathbf{21.92 \text{ Crores.}}$$

Installation including insulation and painting (25-55% of Purchased equipment cost)

The assumed value is 40% of the purchased equipment cost.

$$= \mathbf{8.77 \text{ Crores.}}$$

Instrumentation and controls, installed (6-30% of purchased equipment cost)

The assumed value is 18% of purchased equipment cost.

$$= \mathbf{3.94 \text{ Crores.}}$$

Piping installed (10-80% of purchased equipment cost)

The assumed value is 20% of the purchased equipment cost.

**= 4.38 Crores.**

Electrical accessories installed (10-40% of the purchased equipment cost)

The assumed value is 22% of the purchased equipment cost.

**= 4.83 Crores.**

Buildings and process auxiliary (10-70% of the purchased equipment cost)

The assumed value is 40% of the purchased equipment cost.

**= 8.78 Crores.**

Service facilities and yard improvements (40-100% of the purchased equipment cost)

The assumed value is 100 % of the purchased equipment cost.

**= 21.92 Crores.**

Land (1-2% of the Fixed-capital investment or 4-8% of the purchased equipment cost)

The assumed value is the 23% of the purchased equipment cost.

**= 5.172 Crores.**

Direct Costs = 21.92 + 8.77 + 3.94 + 4.38 + 4.83 + 8.78 + 21.92 + 5.172

**= 79.70 Crores.**

Indirect costs = expanses which are not directly involved with material and labour of actual installation of complete facility.

(15-30% of capital investment)

Indirect cost = Fixed-capital – Direct costs

$$= 102.85 - 79.70$$

$$= \mathbf{23.15 \text{ Crores.}}$$

Engineering and supervision (5-30% of direct costs)

The assumed value is 17.5% of direct costs

$$= \mathbf{1.394 \text{ Crores.}}$$

Construction expenses and contractor's Fee (6-30% of direct costs)

The assumed value is 10 % direct cost

$$= \mathbf{7.97 \text{ Crores.}}$$

Contingency (5-15% of fixed capital investment)

The assumed value is 1% of the Fixed-capital.

$$= \mathbf{1.24 \text{ Crores.}}$$

## **ESTIMATION OF TOTAL PRODUCT COST**

**Manufacturing cost = direct production costs + fixed charges + plant overhead costs**

**Fixed charges (10-20% of the total product cost)**

Depreciation (depends on life period, salvage value, and method of calculation- about 10% of Fixed-capital investment for machinery and equipment and 2-3% of building value for buildings)

The assumed value is 10% of the Fixed-capital investment and 3% of the building value

**= 10.52 Crores.**

Local taxes (1-4% Fixed-capital investment)

The assumed value is 4% of the Fixed-capital investment.

**= 4.14 Crores.**

Insurance (0.4-1% of the Fixed-capital investment)

The assumed value is 1% of the Fixed-capital investment

**= 1.0285 Crores.**

Rent (8-12% of the value of rented land and buildings)

The assumed value 1% of the land and building values

**= 1.45 Crores.**

**Total fixed charges = 10.52 + 4.14 + 1.0285 + 1.45 = 17.1385 Crores.**

**Total product cost =  $17.1385/0.2 = 85.69$  Crores.**

**Direct production costs (about 60% of the total product cost)**

**= 51.414 Crores.**

Raw materials (10-50% of the total product cost)

The assumed value is 25 % of the total product cost

**= 21.422 Crores.**

Operating labour (10-20% of the total product cost)

The assumed value is 15% of the total product cost

**= 12.85 Crores.**

Direct supervisory and clerical labour (10-25 % of operating labour)

The assumed value is 15% of the operating labour

**= 1.930 Crores.**

Utilities (10-20% of the total product cost)

The assumed value is 10% of the total product cost

**= 8.56 Crores.**

Maintenance and repair (2-10% of Fixed-capital investment)

The assumed value is 4% of the Fixed-capital investment)

**= 4.114 Crores.**

Operating supplies cost (10-20% of the cost for repair and maintenance)

The assumed value is the 205 of the cost for repair and maintenance.

**= 0.8228 Crores.**

Laboratory charges (10-20% of the total product cost)

The assumed value is 10% of the total product cost

**= 1.285 Crores.**

Patents and royalties (0-6% of total product cost).

The assumed value is 0.5% of the total product cost

**= 0.4302 Crores.**

Plant overhead costs (50-70% cost for labour ,supervision, and maintenance, or 5-15% of total product cost); includes costs for the following : general plant upkeep and overhead, payroll overhead, packaging, salvage, laboratories, and storage facilities.

Plant overhead costs = **8.569 Crores.**

**Manufacturing cost = 51.414 + 17.138 + 8.569 = 77.121 Crores.**

General expanses = Administrative costs + Distribution costs + Research and  
development costs.

Administrative costs (about 15% of costs for operating labour, supervision, and maintenance, or 2-6% of total product cost); includes costs for salaries, clerical wages, legal fees, office supplies and communications.

The assumed value is 15 % of the cost of operating labour.

**= 1.9275 Crores.**

Distribution and selling cost (2.6% of the total product cost)

**= 2.254 Crores.**

Research and Development (5% of the total product cost)

**= 4.2845 Crores.**

Financing (0.1% of the total Fixed-capital investment)

**= 0.103 Crores**

**Total product cost = 85.69 Crores.**

## **TOTAL INCOME**

The selling price of ethylene oxide in the market = **Rs 48/Kg**

(Source: Coulson & Richardson's, Chemical Engineering, Volume-6)

It is assumed that the seller is given a commission of 10% of the market selling price.

Therefore, the price of ethylene from the factory = **44 /Kg**

Total selling price/year =  $44 \times 300 \times 100 \times 1000 =$  **129 Crores.**

Total income = Gross earning – Total product cost

**= 129 – 85.69 = 43.31 Crores.**

Total profit before depreciation and taxes = **43.31 Crores.**

Depreciation = **10.52 Crores.**

Total profit after depreciation =  $43.31 - 10.52 =$  **32.79 Crores.**

Total profit after 46% taxes = **17.70 Crores.**

Fixed-capital investment = **102.85 Crores.**

Payout period = **4 years**

= **Fixed-capital investment/ [(Net profit after tax/year) + (Depreciation)]**

$$= 102.85/[10.52 + 17.71] = 4\text{years}$$

**Rate of return = Net profit/ Fixed-capital investment**

$$= 17.71/102.85 = \mathbf{10.4\%}$$

## ESTIMATED CAPITAL-INVESTMENT STATEMENT

Product: ethylene oxide.

Basis: 100 TPD

M&S Index: 965

Purchased equipment delivered

21.92

Installation of equipment

8.77

Instrumentation

3.94

Piping

4.38

Electrical installations

4.83

Buildings including services

8.768

Yard improvement

21.92

Land

5.172

**Total physical cost**

**79.70**

Engineering and construction

13.94

**Direct plant cost**

**93.64**

Contractor's Fee

7.97

Contingency

1.24

**Fixed-capital investment**

**102.85**

**Working-capital**

**18.15**

**Total capital investment**

**121**

## ESTIMATED INCOME AND RETURN STATEMENT

Product: Ethylene oxide.	Sales price: Rs- 48/Kg
Basis: 100 TPD	Operating rate: 24Hr/day
M & S Index: 965	Labour rate: 8Hr/shift
Direct production costs	51.414
Fixed charges	17.138
Plant overhead costs	8.569
<b>Factory-manufacturing costs</b>	<b>77.121</b>
Administrative costs	1.9275
Distribution and selling costs	2.254
Research and development	4.2845
Financing	0.103
<b>General expanses</b>	<b>8.569</b>
<b>Total product cost</b>	<b>85.69</b>
<b>Total income</b>	<b>43.31</b>
Fixed-capital investment	102.85
Working capital	18.15

Total capital investment	121
Probable accuracy of estimate	
Gross earnings before taxes	32.79
Net profit after 46% taxes	17.70
Annual return on capital before taxes	31.88
Annual return on capital after 46% taxes	10.4

*(All costs are in Rs Crores.*

*Source for these data is Process Plant Design And Economics For  
Chemical Engineers by Max S. Peters and Kalus Timmerhaus)*

## ESTIMATED MANUFACTURING-COST STATEMENT

Product: Ethylene oxide	Operating rate: 24Hr/day
Basis: 100TPD	Labour rate: 8Hr/day
M&S Index: 965	
Raw materials	21.422
Operating labour	12.85
Operating supervision	1.930
Maintenance and repairs	4.114
Operating supplies	0.8228
Power and utilities	8.56
<b>Direct production cost</b>	<b>50.984</b>
Depreciation	10.52
Rent	1.45
Taxes (property)	4.14
Insurance	1.0285
<b>Fixed charges</b>	<b>17.1385</b>
Control laboratories	1.285
<b>Plant over head cost</b>	<b>9.854</b>
<b>FACTORY-MANUFACTURING COSTS</b>	<b>77.121</b>