

## **: COST ESTIMATION :**

Acceptable plant design must present a process that is capable of operating under conditions, which will yield profit. Since net profit equals total value minus all expenses, it is essential that the chemical engineer be aware of the many different types of cost involved in the manufacturing processes. Capital must allocate for the direct, plant expenses, such as those for raw material, labor and equipment.

Besides direct expenses many others indirect expenses are incurred, and these must be included if a complete analysis of the total cost is to be obtained. Some examples of these indirect expenses are administrative salary, product distribution cost and cost for interplant communication. A capital investment is required for every industrial process and determination of necessary investment is an important part of a plant design process. The total investment for any process consist fixed capital investment for practical equipment and facilities in the plant plus working capital, which must be available to pay salaries, keep raw material and products on hand, and handle other special items requiring the direct cost outline.

When the cost for any type of commercial process is to be determined, sufficient accuracy has to be provided for reliable decision. There are many factors affecting investment and production cost. These are;

1. source of equipment
2. price fluctuation
3. company policies
4. operating and rate of production
5. governmental policies

Before an industrial plant can be put into operation, a large sum of money must be supplied to purchase and install the necessary machinery and equipment.

Land and service facilities must be obtained, and the plant must be erected completely with all piping, controls and services.

The capital needed to supply the necessary manufacturing and plant facilities is called the fixed-capital investment, while that necessary for the operation of plant is termed the working capital. The sum of the fixed capital investment and the working is known as the total capital investment. Generally, the working capital amounts 10-20% of the total capital investment. Following is the breakdown of the fixed capital investment for a chemical process.

#### DIRECT COST:

1. purchased equipments
2. purchased equipment installation
3. instrumentation and control
4. piping
5. electrical equipment and material
6. building (including services)
7. yard improvement
8. land

#### INDIRECT COST:

1. engineering supervision
2. construction expenses
3. contractor's fee
4. contingency

#### TYPES OF CAPITAL COST ESTIMATE:

- Order of magnitude estimate (ratio estimate) based on similar cost data; probable accuracy of this estimate over  $\pm 30\%$ .

- Study estimate based on knowledge of major items of equipment, probable accuracy of this estimate up to  $\pm 30\%$ .
- Preliminary estimate( budget authorization estimate scope method): based on sufficient data to permit the estimate to the budget, probable accuracy of this estimate is within  $\pm 20\%$ .
- Detailed estimate based on complete engineering drawing, specifications and site survey, probable accuracy of this estimate within  $\pm 10\%$ .

COST ESTIMATION OF 150 TONS/DAY OF ACETIC ACID PLANT:

Acetic acid plant size = 150 T/day

Fixed capital investment for cost index of 126 = Rs  $1.1715 \times 10^8$

Cost index for 2002 = 402

Therefore present fixed capital investment =  $1.1715 \times 10^8 \times (402/126)$   
 =Rs 37,37,64,285

Estimation of total investment cost :

1) Direct cost:

a) Purchased equipment cost:(15 – 40% of FCI )

Assume 40% of FCI

=Rs 14,95,05,714

b) Installation cost:(35 – 45% of PEC)

Assume 45%

=Rs 67277571

c) Instrument and control installed:(6 –30% of PEC)

Assume 30% of PEC

=Rs 44851714

d) Piping installation cost:(10 –80% of PEC)

Assume 80%

=Rs.119604571

e) Electrical installation cost:(10 – 40% of PEC)

Assume 40% of PEC

=Rs 59802285

f) Building process and auxiliary:(10-70% of PEC)

Assume 70%

=Rs 104654000

g) Service facilities:(30-80% Of PEC)

Assume 80%

=Rs 119604571

h) Yard improvement:(10-15% of PEC)

Assume 15%

=Rs 22425857

i) Land:(4-8% of PEC)

Assume 8%

=Rs 11960457

Therefore direct cost =Rs. 699686740

**Indirect cost:**

Expenses which are not directly involved with material and labour of actual installation or complete facility

a) Engineering and supervision:(5-30% of DC)

Assume 30%

=Rs 209906022

b)Construction expenses:(10% of DC)

=Rs 69968674

c)Contractors fee:(2-7% Of DC)

Assume 7%

=Rs 48978071

d)Contingency:(8-20% of DC)

Assume 18%

=Rs 125943613

Therefore total indirect cost =Rs 454796380

**Fixed capital investment:**

$$\begin{aligned}\text{Fixed capital investment(FCI)} &= \text{DC+IC} \\ &= \text{Rs } 1154483120\end{aligned}$$

**Working capital investment:**

10 –20% of FCI

Assume 18%

=Rs 207806961

**2) Total capital investment:**

= FCI + WC

=Rs 1362290081

**Estimation of total product cost(TPC):**

**Fixed charges:**

a) Depreciation:(10% of FCI for machinery)

=Rs 115448312

b) Local taxes:(3-4% of FCI)

Assume 4%

=Rs 46179324

c) Insurances:(0.4-1% of FCI)

Assume 0.9%

=Rs 10390348

d)Rent:(8-12% of FCI)

Assume 12%

=Rs 138537974

Therefore total fixed charges =Rs 310555958

But, Fixed charges = (10-20% of TPC)

Assume 20%

Therefore Total product cost =310555958/0.20

=Rs 1552779790

**Direct production:**

a) Raw material:(10-50% Of TPC)

Assume 50%

=Rs 776389895

b) Operating labour(OL):(10-20% of TPC)

Assume 20%

=Rs 310555958

c) Direct supervisory and electric labour:(10-25% of OL)

Assume 25%

=Rs 77638989

b) Utilities:(10-20% of TPC)

Assume 20%

=Rs 310555958

c) Maintenance:(2-10% of FCI)

Assume 9%

=Rs 103903480

d) Operating supplies (OS):(10-20% of maintenance)

Assume 20%

=Rs 20780696

e) Laboratory charges:(10-20% of OL)

Assume 18%

=Rs 55900072

f) Patent and royalties:(2-6% of TPC)

Assume 6%

=Rs 93166787

**Plant overhead cost:**

50-70% of (OL+OS+M = 435240134)

Assume 70%

=Rs 304668093

**General expenses:**

a) Administration cost:(40-60% of OL)

Assume 60%

=Rs 186333574

b) Distribution and selling price:(2-30% of TPC)

Assume 30%

=Rs 465833937

c) Research and development cost:(3% of TPC)

=Rs 46583393

Therefore general expenses(GE) =Rs 698750904

Therefore manufacturing cost(MC)= Product cost+fixed charges+Plant overhead expenses

=Rs 2168003841

**Total production cost:**

Total production cost =MC + GE

=Rs 2866754745

**Gross earnings and rate of return:**

The plant is working for say 335 days a year

Selling price =Rs. 95 /kg for a glacial acetic acid

Total income =100×335×1000×95

=Rs 3182500000

Gross income =Total income – total product cost

=Rs 315745255

Tax =50%

Net profit =Rs 157872627.5

Rate of return =net profit/total capital investment

=157872627.5/1362290081

= 0.1158 =11.58%