

CH0401 Process Engineering Economics

Chapter 2 – Balance Sheet and Cost Accounting

Lecture 2a

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Process Engineering Economics

- 1 Capital requirements for process plants
- 2 Balance Sheets
- 3 Earnings, process and returns (Income statements)
- 4 Economic production, break even analysis charts
- 5 Cost accounting - pre construction cost estimation - allocation of cost.

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Capital Requirement for a Process Plant

Before an industrial plant can be put into operation, large sum of money must be available to purchase and install the required machinery and equipment

The Capital needed to supply the required manufacturing and plant facilities is called *fixed-capital investment*, while the necessary for operation of the plant is termed as *working capital*

Capital Requirement for a Process Plant

The sum of Fixed Capital Investment (FCI) and the Working Capital (WC) is known as the Total Capital Investment (TCI)

$$\text{i.e. } TCI = FCI + WC$$

The Capital needed to supply the required manufacturing and plant facilities is called *fixed-capital investment*, while the necessary for operation of the plant is termed as *working capital*

Methods to find Capital Requirement for a Process Plant

- ▣ Details – items estimate
- ▣ Unit cost estimate
- ▣ **Range of Percentage of delivered/or purchased equipment cost**
- ▣ **Lang factor approximation**
- ▣ Power factor applied to plant/capacity ratio
- ▣ Investment cost per unit of capacity
- ▣ Turn over ratio

Capital Requirement for a Process Plant - *Range of Percentage Method**

Costs	Components	Range of FCI, %
Direct Costs	Purchased Equipment	15-40
	Purchased Equipment Installation	06-14
	Instrumentation and Controls (Installed)	02-12
	Piping (Installed)	04-17
	Electrical Systems (Installed)	02-10
	Buildings (Including Services)	02-18
	Yard Improvements	02-05
	Service Facilities (Installed)	08-30
	Land	01-02
Indirect Costs	Engineering and Supervision	04-20
	Construction Expenses	04-17
	Legal Expenses	01-03
	Contractor's Fee	02-06
	Contingency	05-15

* Typical percentage of FCI values for direct and indirect cost segments for multi purpose plants or large additions to existing facilities is tabulated

Estimation of FCI using the ranges of percentage of process plant costs

Make a study estimate of the FCI for a process plant if the purchased-equipment cost is \$100,000. Use the ranges of process–plant values as given in slide 7 table for the process plant handling both solids and fluids a high degree of automatic controls and essentially outdoor operation. Do not include land.

Generally, when all the percentages are added, they will not total to 100 percent. Therefore, all percentages must be normalized to a total of 100 by dividing each percentage by the total sum over 100. The estimated cost for a component is then calculated as \$100,000 multiplied by the normalized percentage for the equipment.

Process Engineering Economics – *Capital Requirements*

Solution

$$\frac{25}{109} = 22.9$$

$$PC \times NP / NPPE$$

Costs	Components	Selected Range, %	Normalized percentage, %	Estimated Cost, \$	Rounded Values, \$
Direct Costs	Purchased Equipment	25	22.9	100156.24	100000
	Purchased Equipment Installation	9	8.3	36056.25	36000
	Instrumentation and Controls (Installed)	10	9.2	40062.50	40000
	Piping (Installed)	8	7.3	32050.00	32000
	Electrical Systems (Installed)	5	4.6	20031.25	20000
	Buildings (Including Services)	5	4.6	20031.25	20000
	Yard Improvements	2	1.8	8012.50	8000
	Service Facilities (Installed)	15	13.8	60093.75	60000
	Land	0	0.0	0.00	0
Indirect Costs	Engineerig and Supervision	8	7.3	32050.00	32000
	Construction Expenses	10	9.2	40062.50	40000
	Legal Expenses	2	1.8	8012.50	8000
	Contractor's Fee	2	1.8	8012.50	8000
	Contingency	8	7.3	32050.00	32000
Total		109	100	436681.22	436000

PC = Purchased Cost of the equipment, \$

NP = Normalized Percentage for that component, %

NPPE = Normalized Percentage for Purchased Equipment, %

Lang Factor Method

Factor × Delivered equipment cost = FCI or TCI

Type of Plant	Lang Factors	
	FCI	TCI
Solid	4.0	4.7
Solid-Fluid	4.3	5.0
Fluid	5.0	6.0

FCI = Fixed Capital Investment

TCI = Total Capital Investment

This technique originally proposed by LANG has been used in the past for quick-order of magnitude cost estimate for process plants. Lang suggested multiplying the delivered cost of the equipment by the factors stated in the above table to obtain the FCI and TCI.

Lang Factor Method

Example Estimate the total capital investment for a refinery addition for which the delivered or purchased cost is $\$ 8 \times 10^6$. Assume the refinery is a fluid processing plant.

Type of Plant	Lang Factors	
	FCI	TCI
Solid	4.0	4.7
Solid-Fluid	4.3	5.0
Fluid	5.0	6.0

FCI = Fixed Capital Investment

TCI = Total Capital Investment

Solution

$$\text{Total Capital Investment} = 8 \times 10^6 \times 6.0 = \mathbf{\$48,000,000}$$

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