

Chapter 9

PLANT LOCATION AND LAYOUT

The Location Of The Plant Can Have A Crucial Effect On The Profitability Of A Project, And The Scope For Future Expansion. Many Factors Must Be Considered When Selecting A Suitable Site, And Only A Brief Review Of The Principal Factors Will Be Given In This Section. The Principal Factors To Be Considered Are:

- Location, With Respect To The Marketing Area.
- Raw Material Supply.
- Transport Facilities.
- Availability Of Labour.
- Availability Of Utilities: Water, Fuel, Power.
- Availability Of Suitable Land.
- Environmental Impact, And Effluent Disposal.
- Local Community Considerations.
- Climate.
- Political Strategic Considerations.

Marketing Area

For Materials That Are Produced In Bulk Quantities: Such As Cement, Mineral Acids And Fertilizers, Where The Cost Of The Product Per Ton Is Relatively Low And The Cost Of Transport A Significant Fraction Of The Sales Price, The Plant Should Be Located Close To The Primary Market. This Consideration Will Be Less Important For Low Volume Production, High-Priced Products; Such As Pharmaceuticals. In An International Market, There May Be An Advantage To Be Gained By Locating The Plant Within An Area With Preferential Tariff.

Raw Materials

The Availability And Price Of Suitable Raw Materials Will Often Determine The Site Location. Plants Producing Bulk Chemicals Are Best Located Close To The Source Of The Major Raw Material; Where This Is Also Close To The Marketing Area.

Soda Ash Plant Should Be Located Near The Salt Lakes Or Near Sea, Where Sodium Chloride Is Available Abundantly.

Transport

The Transport Of Materials And Products To And From Plant Will Be An Overriding Consideration In Site Selection.

If Practicable, A Site Should Be Selected That Is Close At Least Two Major Forms Of Transport: Road, Rail, Waterway Or A Seaport. Road Transport Is Being Increasingly Used, And Is Suitable For Local Distribution From A Central Warehouse. Rail Transport Will Be Cheaper For The Long-Distance Transport Of Bulk Chemicals.

Air Transport Is Convenient And Efficient For The Movement Of Personnel And Essential Equipment And Supplies, And The Proximity Of The Site To A Major Airport Should Be Considered.

Availability Of Labour

Labour Will Be Needed For Construction Of The Plant And Its Operation. Skilled Construction Workers Will Usually Be Brought In From Outside The Site, But There Should Be An Adequate Pool Of Unskilled Labour Available Locally; And Labour Suitable For Training To Operate The Plant. Skilled Tradesmen Will Be Needed For Plant Maintenance. Local Trade Union Customs And Restrictive Practices Will Have To Be Considered When Assessing The Availability And Suitability Of The Labour For Recruitment And Training.

Utilities (Services)

The Word “Utilities” Is Now Generally Used For The Ancillary Services Needed In The Operation Of Any Production Process. These Services Will Normally Be Supplied From A Central Facility; And Will Include:

- Electricity: - Power Required For Electrochemical Processes, Motors, Lightings, And General Use
- Steam For Process Heating: - The Steams Required For The Process Are Generated In The Tube Boilers Using Most Economic Fuel.
- Cooling Water: - Natural And Forced Draft Cooling Towers Are Generally Used To Provide The Cooling Water Required On Site.

- Water For General Use: - The Water Required For The General Purpose Will Be Taken From Local Water Supplies Like Rivers, Lakes And Seas. Because Of This Reason All The Plants Located On The Banks Of River.
- Dematerialized Water: - Dematerialized Water, From Which All The Minerals Have Been Removed By Ion-Exchange Is Used Where Pure Water Is Needed For The Process Use, In Boiler Feed Water.
- Refrigeration: - Refrigeration Is Needed For The Processes, Which Require Temperatures Below That Are Provided By The Cooling Water.
- Inert-Gas Supplies.
- Compressed Air: - In An Ethylene Oxide Plant Compressed Air Is One Of The Raw Materials. It Is Also Needed For Pneumatic Controllers Etc.
- Effluent Disposal Facilities: - Facilities Must Be Provided For The Effective Disposal Of The Effluent Without Any Public Nuisance.

Environmental Impact, And Effluent Disposal

All Industrial Processes Produce Waste Products, And Full Consideration Must Be Given To The Difficulties And Cost Of Their Disposal. The Disposal Of Toxic And Harmful Effluents Will Be Covered By Local Regulations, And The Appropriate Authorities Must Be Consulted During The Initial Site Survey To Determine The Standards That Must Be Met.

Local Community Considerations

The Proposed Plant Must Fit In With And Be Acceptable To The Local Community. Full Consideration Must Be Given To The Safe Location Of The Plant So That It Does Not Impose A Significant Additional Risk To The Community.

Land (Site Considerations)

Sufficient Suitable Land Must Be Available For The Proposed Plant And Future Expansion. The Land Should Be Ideally Flat, Well Drained And Have Load-Bearing Characteristics. A Full Site Evaluation Should Be Made To Determine The Need For Piling Or Other Foundations.

Climate

Adverse Climatic Conditions At Site Will Increase Costs. Abnormally Low Temperatures Will Require The Provision Of Additional Insulation And Special Heating For Equipment And Piping. Stronger Locations Will Be Needed At Locations Subject To High Wind Loads Or Earthquakes.

Political And Strategic Considerations

Capital Grants, Tax Concessions, And Other Inducements Are Often Given By Governments To Direct New Investment To Preferred Locations; Such As Areas Of High Unemployment. The Availability Of Such Grants Can Be The Overriding Consideration In Site Selection.

PLANT LAY OUT

The economic construction and efficient operation of a process unit will depend on how well the plant and equipment specified on the process flow sheet is laid out. The principal factors are considered are:

- Economic considerations: construction and operating costs.
- The process requirements.
- Convenience of operation.
- Convenience of maintenance.
- Safety.
- Future expansion.
- Modular construction.

Costs

The cost of construction can be minimized by adopting a layout that gives the shortest run of connecting pipe between equipment, and at least amount of structural steel work. However, this will not necessarily be the best arrangement for operation and maintenance.

Process requirements

An example of the need to take into account process consideration is the need to elevate the base of columns to provide the necessary net positive suction head to a pump or the operating head for a thermosyphon reboiler.

Operations

Equipment that needs to have frequent attention should be located convenient to the control room. Valves, sample points, and instruments should be located at convenient positions and heights. Sufficient working space and headroom must be provided to allow easy access to equipment.

Maintenance

Heat exchangers need to be sited so that the tube bundles can be easily withdrawn for cleaning and tube replacement. Vessels that require frequent replacement of catalyst or packing should be located on the out side of buildings. Equipment that requires dismantling for maintenance, such as compressors and large pumps, should be places under cover.

Safety

Blast walls may be needed to isolate potentially hazardous equipment, and confine the effects of an explosion.

At least two escape routes for operators must be provided from each level in process buildings.

Plant expansion

Equipment should be located so that it can be conveniently tied in with any future expansion of the process.

Space should be left on pipe alleys for future needs, and service pipes over-sized to allow for future requirements.

Modular construction

In recent years there has been a move to assemble sections of plant at the plant manufacturer's site. These modules will include the equipment, structural steel, piping and instrumentation. The modules are then transported to the plant site, by road or sea. The advantages of modular construction are:

- Improved quality control.
- Reduced construction cost.
- Less need for skilled labour on site.

Some of the disadvantages are;

- Higher design costs & more structural steel work.
- More flanged constructions & Possible problems with assembly, on site.

The Plant Layout KEYWORDS

1. Raw material Storage
2. Product Storage
3. Process Site
4. Laboratories
5. Workshop
6. Canteen & Change house
7. Fire Brigade
8. Central Control Room
9. Security office
10. Administrative Building
11. Site for Expansion Project.
12. Effluent treatment plant
13. Power house
14. Emergency water storage
15. Plant utilities

A detailed plant layout is drawn and submitted with this thesis report.

Some general considerations that influenced the plans follow:

1. Space was set aside for a whole new train. This appears as dotted lines in the figures.
2. The prevailing wind in the summer comes from the northwest and in the winter comes from the west.
3. The blow down tank is located on the south side of the plant where winds will not generally carry any spills over the plant.
4. The utilities and the waste treatment areas are located on the north side of the plant where they will be upwind of the plant.
5. The styrene storage will be located on the south side of the plant 300ft from the river and the dock. It will be 300ft from the processing area.
6. The warehouse and the bulk storage will be located on the west side, upwind from the plant and styrene storage. They will be at least 250ft from reactor area.
7. The reactor and the feed preparation area will be on the east side of the plant 200ft from the river.
8. The other processing areas will be between the reactor area and the warehouse. They will be over 200ft from the reactor area.

Some specific considerations follow:

1. There must be enough headroom above the reactor to remove the agitator.
2. There must be enough room to remove the screw from the extruder.
3. Gravity feed is to be used for charging additives to the reactor, for discharging the reactor to the hold tanks, and for feeding the dryer.
4. Each of the styrene storage tanks will have a dike around it that is capable of containing the tank's contents when it is full.