

## **Chemical Process Selection, Design and Operation**

Adequate and flexible initial design is essential for the promotion of a chemical plant organic product or inorganic product.

In older days it was classified as inorganic chemical technology and organic chemical technology. Subsequently the oxford university made it as chemical works organization and management.

Some factors that must be considered in planning a plant are discussed in this section. The Process Engineer is an expert in the current aspects of chemical process design. Practical experience is a must if the senior design engineer is able to foresee and solve the problems of production, such as maintenance, safety and obeying the government, environmental by loss and control.

Experience consultants either individuals or professional consulting firms are able to advise, design and for erection of chemical plants.

## **Chemical Process Control and Instrumentation**

Automatic and Instrument control chemical processes are common and essential. Instruments should not be chosen simply to record a variables, of the process. But their function is to assure consistent quality by sensing controls, recording and maintaining desired operating conditions. Instruments are the essential tool for modern processes. They are classified as

1. Indicating Instruments
2. Recording Instruments
3. Controlling Instruments

Two types of Instruments are currently used as analogue and digital.

Analogue Instruments such as pressure spring thermometers and Bourden Gauges shows results by mechanical moments of some type of device which is directly proportional to the quantity measured.

On the other hand, digital devices are converts the quantity measured into a signal and electric circuits converts the signal to read the numerical values forward by control. Now the computers can monitor and regulate outputs from both the analogue and digital devices according to a prearranged program, also general conventional digital inputs are required. Chemical analytical control has been used in day to day factory procedures for analysis of incoming raw material or outgoing products. Thus quality chemicals are produced more in these days reliably their when human analysed control were used.

The latest advancement are the chromatography system, many spectroscopy have been automated an install of on-line basis for the process to run continuously without the problems encountered manually before.

## **Role of Chemical Engineers**

Chemical Engineers are trained primarily to work in chemical industries. some of the vital role of the chemical engineers are as follows;

### **Chemical Process Economics**

Engineer are totally different from Scientist by their customers of cost of production and profit generator. Therefore the objective of engineer should be to deliver safely the best product or most efficient service at lower cost to the employer and the public who consumes the product.

### **Material Balance**

Yield and conversion are the chemical prospects from the basis for the material balances which is useful for cost determination.

Materials and their quantities from the standard practices are tabulated in the flow charts, energy given are observed for the chemical reactions and energy is frequently a major cost in chemical plants but it often possible by altering the process procedures by using modern separation technologies like "RO" and "Advanced Separation Processes" to produce high quality chemicals with low energy consumption.

### **Plant Location**

The location of the chemical plant is decided ourselves by the availability of raw materials, transportation, market and power. Now the environmental constituents, water supply, availability of efficient labor, cost of land and waste disposal facilities form the criteria for the plant location.

### **Construction of Plant**

For small and large companies construction engineering organizations are available that will built a plant and participate in its design. Some large chemical companies have their own civil construction department and starts their own plants.

The advancement of this is the worker who is going to operate the equipment can be more intimately corrected to the constructions and be familiar themselves for the future alternatives, expansion or modifications.

In built-in plants the top engineers are chartered engineers qualified for the development activities. They have been trained and suitably examined to guarantee technical competency and owe personal responsibility. They are now called as functional consultants and registered firm for dealing with legal aspects with proper training.



## **Research and Development**

adequate and skilled research with patent protection is necessary for future profits. In the chemical process industries one of the outstanding tactics is rapidly changing processes, new raw materials and new markets. Research creates these changes and the factory will have a competitive progress. This research brings about development and the adoption of ideas, concepts, methodologies form the production of the industry. The results and benefits of research establishes the developing country on the road of progress and raise the level of life of common man.

### **Chemical Engineer in coming years**

1. Resources particularly energy and feed back for the Fertilizers and Heavy Chemical Industries.
2. Infrastructure for Transportation and Telecommunications.
3. Protection of the Environment.
4. Development of Agro Industries where utilization of waste from Agro industries and exploitation of value added products from wastes.
5. Transformation of Rural Economy, Industrialization and Privatization where the profits are less and consumption is more.
6. Problems of less Technical context are,
  - The Centre Vs. States
  - Command Economy Vs. Liberalisation & Privatisation
  - Internal Budget and External Balances
  - World Trade Globalization and relevant to India
  - Problem of Indian competitiveness

The latest research and development have classified the following new industries;

1. Cryogenics in Chemical Technology
2. Chemicals from Sea
3. Air as a Chemical Raw Material
4. NUPLEXES ( Nuclear Power Agro Industrial Complexes )
5. Proteins from Petroleum Fermentation and Single Cell Proteins from Animal horns.
6. Food Industries
7. Coal Chemicals
8. Newer Petrochemicals
9. Pesticides
10. Pharmaceuticals Industries
11. Metallurgical Industries
12. Water treatment & Air Pollution Control

The chemical process industry had its growth from pre scientific chemical industries followed by scientific chemical industry. The growth with restrains, green challenge to chemical industry and the modern separations process involved in the indian chemical industry seen today.

## Unit Operation

The basic physical operations of chemical engineering in a chemical process plant, that is distillation, fluid transportation, heat and mass transfer, evaporation, extraction, drying, crystallization, filtration, mixing, size separation, crushing and grinding, and conveying. In simple terms, the operation which involves **physical changes** are known as Unit Operation.

1. Distillation is a unit operation is used to purify or separate alcohol in the brewery industry.
2. The same distillation separates the hydrocarbon in a petroleum industries.
3. Dry grapes and other food products or similar drying of filter precipitate like rayon industry where yarn is produced.
4. Absorption of oxygen from air in a fermentation process of a sewage treatment plant and half hydrogen gas in a process for liquid hydrogenation of oil.
5. Evaporation of salts solutions similar to evaporation of sugar solution in the industry.
6. Settling and sedimentation of suspended solids similar to minimizing and sewage treatment plant.
7. Flow of liquid hydrocarbon in a petroleum refinery and flow of milk in a dairy plant for the solidification in spray dryer.

## Classification of Unit Operations

1. **Fluid Flow** : Concerns the principle that determine the flow or transformation of fluids from one point to another. The fluid can be a liquid or a gas. This unit is entirely based on Bernoulli's equation followed by continuity correlation.
2. **Heat Transfer** : Deals with principles that govern accumulation and transfer of heat and energy from one place to another. The three concepts followed here are conduction, convection and radiation.



3. **Evaporation** : A special case of heat transfer which deals with the evaporation of volatile solvent such as waste from a non-volatile solute such as salt or any other material in the solution. The evaporation of trichloro-ethylene a cleaning agent in the automobile service industry and acetone in the case of glassware in a chemical process industries follow this unit operations.
4. **Drying** : An operation in which volatile liquids (usually water) are removed from solid material.
5. **Distillation** : An operation where a components of the liquid mixture are separated by boiling because of their difference in vapor pressure.
6. **Absorption** : A process whereby a component is removed from gas mixture by treatment with liquid.
7. **Liq-Liq Extraction** : A process in which a solute in a liquid solution is removed by contact with another liquid solvent that is relatively irreversible with solution.
8. **Liq=Solid Leaching**: It involves treating a finely divided solid with a liquid that dissolves and removes a solute contain in the solid.
9. **Crystallization** : The removal of a solute such as a salt from solution by precipitation in the industries for large scale operations, electrostatic precipitation is operated for this concept.
10. **Mechanical physical separation**: This involves separation of solids, liquids or gases by mechanical means such as filtration, settling, size reduction which are classified as separate unit operations.
  - The outline of unit operation defines the settling tanks for sedimentation, filter press for separations, pressurized spheres for ammonia storage, pellatising for fertilizer compounds, pneumatic conveyors for cement industry, bucket wheel elevators for thermal power stations and belt conveyors for core industries and many more in operation.

