

* Modern Approach to Chemical Industry *

* Introduction :->

India has become a big platform for chemical industries from last 30 years. Chemical industry is expanding its horizons for e.g. Sugar, plastic, rubber, soap, detergents, cosmetics, pharmaceuticals, dyes, paints, fertilizers, pesticides, insecticides, papers, kerosene, glass, hydrogenated oil, etc. Chemistry is backbone of chemical industry. Chemical industries comprises both small and large scale units and presently about 70,000 chemical manufacturing unit^{are} located in our country. Government of India recognise chemical industry as a key growth element of Indian economy. In chemical industries manufacture of product from raw material is carried out by physical and chemical changes.

* Basic requirements of Chemical Industries :->

- ① selection of product.
- ② Raw material must be abundant.
- ③ Cost of land is low.
- ④ Ample water supply.
- ⑤ Mode of transport such as land, air, water etc.
- ⑥ Electricity.
- ⑦ Fuel.
- ⑧ Facilities for waste disposal.

* Chemical production :->

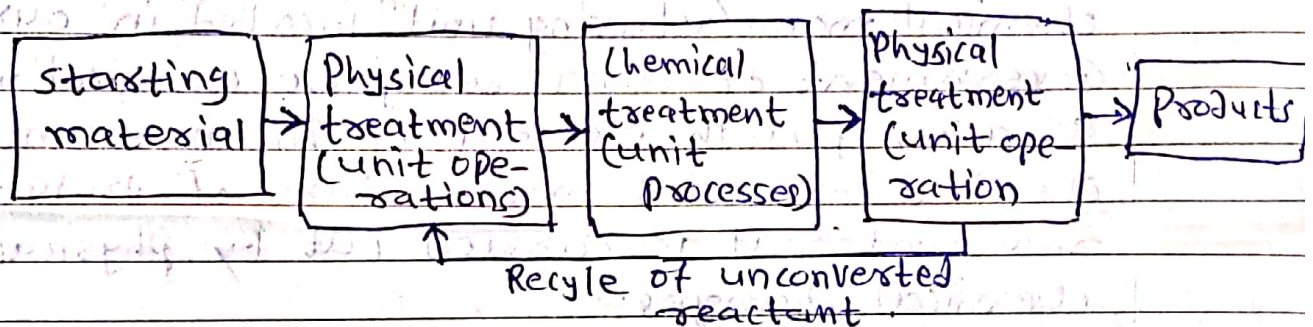
Raw materials are passes through series of the physical and chemical process to obtain final product.

Chemical production = Raw material + unit process + Unit operation + quality control + quality assurance + process control + pollution control.

The choice of cheap, pure, abundant and readily available raw material is one of the most important asset in the chemical production.

The quality and yield of chemical product depends upon the purity of raw material.

Typical chemical process is presented in the following figure.



* Raw Materials :->

Any substance or a chemical which can be processed to produce the desired product is called the raw material. There are two types of raw material.

① Occurring in natural form e.g. Hydrogen, Oxygen, Chlorine etc.

② Product of any other Industry e.g. Sodium chloride, caustic soda, molasses etc.

Raw materials should be easily available, cheap, located near the factory, stable and safe. It should be not hazardous to the environment and the people residing near by. It should pass all the various government criteria's and regulations. The cost of production can be minimized if the raw material is abundant and cheap.

* Unit Process and Unit operations :->

Unit process :-> The process of converting raw material to the finished product by carrying out different chemical reactions under controlled conditions is called unit process.

- e.g.
- | | |
|--------------------------|------------------|
| ① Alkylation | ② Esterification |
| ③ Nitration | ④ Oxidation |
| ⑤ Hydrogenation | ⑥ Sulphonation |
| ⑦ Carboxylation | ⑧ Reduction |
| ⑨ Diazotization | ⑩ Hydrolysis |
| ⑪ Neutralisation | ⑫ Halogenation |
| ⑬ Amination | ⑭ Polymerization |
| ⑮ Friedal Craft reaction | ⑯ Condensation |

Unit operations :-> The operations involving engineering for a particular reason or purpose and with the help of special equipment designed for the same purpose are known as unit operations.

In unit operation the raw material has to undergo several physical changes before and after a chemical change.

- e.g.
- | | |
|----------------------|------------------|
| ① Heat transfer | ② Adsorption |
| ③ Crystallisation | ④ Evaporation |
| ⑤ Filtration | ⑥ Centrifugation |
| ⑦ Solvent Extraction | ⑧ Screening |
| ⑨ Mixing | |

* Quality Control :-> (Q.C.)

Quality control is a system of routine technical activities to measure and control the quality of the inventory as it is being developed. Quality control is of immense importance in

any chemical process industry. It is the integral part of the chemical production and involves the analysis or testing of the raw materials and the finished products for their standard specifications. Different industries require different quality and purity of compounds. The terms such as technical grade, analytical grade, reagent grade, spectroscopic purity etc. are used to denote the degree of purity and quality of the compounds. Quality control can also be effected by testing the properties such as melting point, boiling point, refractive index, colour, odour, tensile strength etc.

* Quality Assurance \Rightarrow (Q.A.):

Quality assurance is a way of preventing mistakes or defects in the manufactured product and avoiding problems when delivering solutions or solutions to customers.

Quality assurance includes quality control, but it also refers to emphasis on quality in the design of products, processes and jobs and in personnel selection and training. It also includes behavioural science based techniques like quality circles, zero defect programmes. Naturally, the management of quality is an extensive area of study.

* Process control \Rightarrow

The control of variables such as temp. concentration, pressure, time, flow rate of reactant etc. for getting the desired product

in an economic way is called process control.

Process control is frequently tied up with the quality control during production. The process control involves three steps.

- (i) Analysis of incoming raw material.
- (ii) Analysis of intermediate product during manufacturing.
- (iii) Analysis of final products.

* Research and Development → (R and D.)

The research and development as stated by the organization for economic co-operation and development related to creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and use of this stock of knowledge to devise new applications. The R and D department has following functions.

- ① To update the industry with the users needs.
- ② Optimise the reaction conditions in order to obtain higher product yield in low cost and low reaction time.
- ③ To design and synthesize new products.
- ④ To search cheap inexpensive raw materials.
- ⑤ To increase the quality of the product to sustain in the market.
- ⑥ To minimise the wastage and decrease the cost of pollution control.
- ⑦ Patented the new products and processes.
- ⑧ To develop new efficient inexpensive catalyst.
- ⑨ To avoid the accidents in the industry.
- ⑩ Use all byproducts properly and make industry profitable.

* Pollution control :->

Pollution control is a process of reducing or eliminating the release of pollutants into the environment. It is regulated by government and several environmental agencies that establish limit for the discharge of pollution into the air, water and soil. A wide variety of devices and systems have been developed to control air, water and solid wastes.

Pollution control is of three types:

(i) Air pollution control: Air pollution control are divided into two categories. (a) control the particulate emission and (b) control the gaseous emission.

(ii) Water pollution control: It can be controlled by (a) Physical (b) chemical (c) Biological methods.

(iii) Solid pollutants: This consists of garbage, sewage, sludge, paper, plastic, waste material. One method of dealing with solid pollutant is simply to bury them in dumps or land fills.

* Human Resource :->

Human resources are the major factor associated with all activities of chemical or any type of industries. The progress of the industries depends upon the availability of the skilled and cheap human resources.

Human resource department deals with performance appraisal and development, feedback and performance, coaching, training, career planning, employee welfare and quality of work life, rewards, organisational development and system development etc.

* Safety Measures :->

Safety measures ensures all precautions regarding well being of human resource so that any accident can be avoided leading to no loss to human body or health. The regulations are laid down by laws and private authorities to issue workplace health and safety regulations. Following are the safety precautions required for the chemical industries.

- ① The workers must train to handle hazardous chemicals.
- ② The fuming hoods must use to carry the chemical reactions with hazardous chemicals.
- ③ Chemicals should not be handled without hand gloves and safety spectacles.
- ④ Fire extinguisher, first aid box should be kept in each department near the working places.
- ⑤ Arrangements of water showers are necessary.
- ⑥ Training should be given to use the safety equipments at the time of accidents.
- ⑦ Accident and mediclaim policies of each person in the industry should be made compulsory.

* Classification of Chemical Reactions :->

Chemical reaction can be classified in numbers of ways.

(Chemical reaction are classified according to reaction such as synthesis, combustion, substitution, decomposition, double replacement.

According to phase involved in reaction they are divided into two types.

- ① Homogenous Reaction
- ② Heterogenous Reaction.

- ② Apparatus is idle during charging and discharging. ② The apparatus is not idle during charging and discharging.
- ③ It requires more manual labour. ③ It requires less manual labour.
- ④ Temp., pressure, concⁿ etc. may not remain constant in all batches. ④ Temp., pressure, concⁿ remain constant through out the operation.
- ⑤ Rate of reaction does not remain constant during entire process. ⑤ Rate of reaction remain constant due to full automation.
- ⑥ More energy is required due to alternate heating and cooling. ⑥ Less energy is required and waste is immediately used for preheating the raw materials.
- ⑦ Less product per man hour is obtained. ⑦ More product per man hour is obtained.
- ⑧ Quality control is difficult. ⑧ High quality control is obtained.
- ⑨ Less expensive equipments are required. ⑨ More expensive equipments are required.
- ⑩ Less profitable. ⑩ More profitable.

* Conversion :->

Conversion is expressed as a % and is related to the amount of reactant that is chemically converted to another substance. The reaction conditions are optimise in order to obtain 100% conversion of the reactants into products. The unreacted material in the product becomes a impurity and it requires further purification.

* Selectivity :->

The term selectivity refers to increasing the % of one of the products by keeping conditions favourable to the formation of that product using suitable catalyst.

* Yield :->

It is defined as the amount of product formed from given amount of starting material in the reaction. It is expressed in % or grams.

* Copyright Act :->

Copyright act is the set of exclusive rights granted to the author or creator of an original work, including the right to copy, distribute and adapt the work.

Copyright lasts for a certain time period after which the work is said to enter the public domain. Copyright applies to a wide range of works that are substantive and fixed in a medium. Some jurisdictions also recognise "moral rights" of the creator of a work, such as the right to be credited for the work.

Since the 19th century the copyright is described under the Umbrella term intellectual property along with patents and trademarks. Copyright has been internationally standardized, lasting between fifty and one hundred years.

* Patent act :->

Similar to other properties like wealth,

the intelligence in human is also a valuable asset. The person spent time, money and his intelligence to develop new things, which are beneficial to others. The new invention is used by industries or users and make the profit. The person who developed these new technique shall also get benefit hence there is a provision of patent acts.

The procedure of permitting patents, the demands placed on the patentee and the scope of the exclusive rights vary from nation to nation. It depends upon the national laws of the particular state or country. For a patent application the most important condition is that the invention must be new. It must also be innovative and applied. The most important right to grant a patent is to prohibit others from making, using, selling or distributing the patented invention without permission.

A patent is a permit of absolute right to the inventor to his invention for a restricted period of time.

* Trademark :->

The trademark or trade mark is a distinctive sign or indication. It is used by an individual, business organization or other legal entity or point out that the product or services to clients with which the trademark comes out from a unique source and to distinguish its products or services from those of other

things.

A trademark is symbolised by the following sign.

- for an unregistered service mark. i.e. mark used to promote or band services.
- ® for registered trademark.

A trade mark is a type of intellectual property laws. It signifies to the name, word, phrase, logo, image, design, symbol or combination of any or all of these elements. The trademark grants rights to the owner which in turn make take or can start legal action in case of infringement of trademark. The registration is not compulsory in trademark. The owner of a common law trademark may also file suit but an unregistered mark may be protectable only within the geographical area within which it has been used.

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EXERCISE

Q. 1. Answer the following (1 mark) :

1. Define the term conversion.
2. Define the term selectivity.
3. Define the term yield.
4. Explain the term quality control.
5. Explain the term quality assurance.
6. Explain the term copyright act.
7. Explain the term trademark act.
8. Explain the term patent act.

Q. 2. Answer the following (3 mark) :

1. Explain the terms conversion, selectivity and yield
2. Distinguish between batch and continuous process
3. Explain the terms copy right act, trademark act and patent act
4. Give the classification of chemical reactions.
5. Explain the role of R&D in the chemical industries.
6. What is the basic requirement of chemical industries?

Q. 3. Tick mark the correct answer (1 mark) :

1. Quality Control involves
 - a) analysis of finished product
 - b) maintenance of desired level of quality in the product
 - c) testing of raw materials and finished products
 - d) analysis of incoming raw materials
2. Leaching, drying, crushing, Agitation operation involve
 - a) QC and QA
 - b) pollution Control
 - c) chemical change
 - d) physical change
3. Resourcing, Business, training and development involves
 - a) R&D
 - b) HR
 - c) QA/QC
 - d) PC
4. Alkylation, Combustion & sedimentation involves under
 - a) Unit Process
 - b) Unit Operations
 - c) QA/QC
 - d) PC

5. Industrial properties involves

a) Musical Work b) Artistic works

c) Literary work

d) Industrial designs

Q. 4. State whether the following statements are true or false.

1. Chemistry is the backbone of chemical industry.
2. The industries which produce aluminum, steel are included under list of chemical industries.
3. Raw materials may be naturally occurring or they may be end products of other industries.
4. Unit process should not be economically profitable.
5. Quality control is not important in chemical industry.
6. Batch operation and continuous operations means the same.
7. In deciding the cost of product the power consumption is important.
8. QA/QC program contributes to the goal of good practice.
9. Process control and quality control are always tied up together.
10. Copyright is symbolized as 'C'.
