Institute of Science and Technologie

Department of Science and Technology / Study: Process Engineering Module: Engineering professions / Semester 2 / Section A

Engineering Professions Course (Process Engineering part).

Chapter I

1- Definition of Process Engineering

Process engineering refers to the application of chemistry on an industrial scale. Its aim is the transformation of matter in an industrial context and consists of the design, sizing and operation of a process comprising one or more chemical and/or physical transformations. Methods used in a laboratory are often not suitable for industrial production from an economic and technical point of view.

2- History of process engineering

In 1915 Arthur D. Little who proposed the concept of unit operations in response to the growing demand for cheap commodities. The concept of unit operation assumes that all manufacturing processes can be broken down into a series of elementary operations such as:

- Drying
- Crystallization
- Filtration
- Vaporization
- Distillation
- Electrolysis

3- Definition of industrial chemistry

Industrial chemistry is the economic activity that produces molecules and other chemical compounds in large quantities, called industrial, by exploiting chemical engineering technologies. Industrial chemistry therefore appears to be an essential science for all those who want to implement production processes.

Since the mid-19th century, applied chemistry and then industrial chemistry has been considered part of the body of knowledge that represents chemistry as a science.

A. Chemical engineering:

Chemical engineering is located at the convergence of several disciplines and studies the transformations, transports and transfers of matter, energy and momentum to establish laws and correlations that can be used during transposition or extrapolation to an industrial scale. And it is also the body of scientific and technical knowledge which aims to design and implement a chemical plant and optimize its production.

The task of the chemical engineer is:

- Sizing
- Manufacturing
- Operation

Chemical engineering opportunities:

- Oil industry, particularly refining
- Chemical industries (plastic industry, detergent, cosmetics)
- Pharmaceutical industries
- Food industries (juices, yogurts)
- Electronic industries.

B. Environmental engineering

It predicts and measures the impact of production methods on the environment, and then offers suitable solutions to control air and water pollution and manage waste.

It strives to ensure compliance with regulations in force and to avoid ecological disasters (factory explosions, oil sinkings), it also ensures that industrial production is hampered as little

as possible, and thus controls the cost of reducing pollution. pollution. Environmental engineering has multiple skills:

- Solid scientific and technical knowledge in health, safety and the environment
- It also ensures constant monitoring of environmental regulations and standards

Environmental engineering opportunities:

- Depollution of waste water
- Depollution of gaseous effluents
- Soil decontamination
- Solid waste treatment
- Industrial hygiene

C. Pharmaceutical engineering

Pharmaceutical process engineering is a discipline that aims to apply process engineering operations in the pharmaceutical industry for the manufacture of drugs. Also is a discipline which brings together the majority of technologies linked to the formulation of drugs and their industrial production under conditions of optimal efficiency and satisfying the strictest good manufacturing practices.

This training aims to:

- Train a production or engineering career in the pharmaceutical, food, phytopharmaceutical, and cosmetics industries
- Allow the acquisition of cutting-edge techniques in these industries
- Address the specific problems of the pharmaceutical industry

Pharmaceutical engineering opportunities:

- The integration of engineering sciences in the approach to pharmaceutical production, filtration of air and fluids, automation of pharmaceutical processes
- Acquiring the basics required to tackle problems such as production in a sterile environment, production of water for pharmaceutical use, production of solid, liquid and semi-solid forms, etc.
- The form of pharmaceutical drugs (galenic) also industrial development, manufacturing and/or packaging

4. What is an industrial process?

An industrial process is a mechanical or chemical process intended to produce objects or synthesize chemical products in large quantities and under technically and economically acceptable conditions. They are particularly essential to so-called heavy industries.

5. The role of process specialty

The processes are applied in a wide range of industries, on site:

- Chemical and para-chemical industry (plastic, synthetic textile, synthetic rubber (elastomer), detergent, adhesive, fertilizer)
- Pharmaceutical industries
- Oil refining and petrochemicals
- Environment: treatment of water, air and waste
- Food industry and bio-industries
- Quality and safety in processes
- Management of industrial processes

Chapter II Hydrocarbons and petrochemical industry

1. Definition

A hydrocarbon (HC) is an organic compound consisting exclusively of carbon (C) and hydrogen (H) atoms, their crude formula is: Cn Hm where (n and m) are two natural numbers. They can be saturated, called alkanes, or unsaturated (alkenes, alkynes and aromatic compounds).

Hydrocarbons are flammable, like oil and natural gas, so they do not mix with water (immiscible).

2. The different hydrocarbons

Hydrocarbons are classified according to their nature:

Hydrocarbons	Examples	Sources
Saturated: the carbon chain is made up only of single bonds	**Alkane:** called paraffins. These are composed very little reactive. They don't give each other cold no reaction with chlorine, nor bromine. But their reaction with oxygen, hot or under the action of bright light, releases a large amount of heat with the formation of carbon dioxide and water. The general formula: C_nH_{2n+2}	Their main source is oil. The combustion of alkanes is the main source of energy used. Petroleum is made up largely of alkanes resulting from deposits of organic matter buried at the bottom of the oceans
Unsaturated: the carbon chain has at least one double or triple bond	**Alkene:** hydrocarbon derived from alkanes, containing the C=C double bond and of the general form CnH2n. an alkene is capable of absorbing hydrogen in the presence of a catalyst at	Not present, or very rarely in oils. On the other hand, they are common in plant or animal biological compounds, but rarely in the form of simple compounds.

	ordinary temperature and pressure, forming a alkane **Alkyne:** hydrocarbon derived from alkanes, containing a triple C≡C bond and general formula: C_nH_{2n-2}. The triple bond represents the lightest of the family is acetylene (Ethyne). **Aromatic:** all aromatic compounds are derived from benzene. Their overall formula C_6H_6	Although represented in certain natural molecules the triple bond is quite rare This structure is presented in many original molecules plant or animal. Benzene is mainly extracted from coal tars or petroleum residues.

- **Where do oil and gas hydrocarbons come from?**

These are assemblies of carbon and hydrogen atoms in greater or lesser quantities for oil and gas.

They come from the accumulation of deposits of marine organisms at the bottom of the oceans during tens of millions of years of the formation of the earth, during which sediments were formed. These sediments over time formed hard primary rocks which became reservoir rocks in which the hydrocarbon molecules were initially contained at great depth. Coal gas called Grisou which is methane, a component of natural gas.

2. Definition of petrochemicals

a. Petroleum

Petroleum is a liquid of natural origin, a mineral oil composed of a multitude of organic compounds, essentially hydrocarbons trapped in particular geological formations, because petroleum provides almost petroleum all liquid fuels (fuel oil, diesel, kerosene, gasoline, LPG)

while naphtha produced by refining is the basis of petrochemicals, from which a very large number of common materials are derived.

b- Petrochemicals

Petrochemicals is the industry that traditionally transforms fossil resources, such as liquefied petroleum gas (LPG) propane or butane, naphtha or diesel (oil cuts) and ethane (natural gas), into large petrochemical intermediates, which will themselves be used by the chemical industry in the production of multiple end products (plastics, textile fibers, etc.).

Broadly speaking, the two main processes involved in petrochemicals are steam cracking; capable of transforming gas or naphtha into olefins such as ethylene, propylene, butenes and butadiene and reforming; catalytic converter that only processes naphtha to produce major aromatic intermediates such as benzene, toluene and xylenes.

What is the petroleum and gas industry?

The and gas industry is defined by upstream activities, which occur before oil and gas extraction, and downstream activities, which occur after oil and gas extraction.

- Upstream activities: include searching for and discovering oil deposits and testing them to determine their value.
- Downstream activities: include the extraction of deposits, production, shipping, refining and sale of crude oil and natural gas discovered underground. Manufacturers use these resources to make heating oil, motor oil, propane, gasoline, kerosene, butane, methane, benzene and tar.

4. Petrochemical product

The products resulting from petroleum refining are complex mixtures of hydrocarbons, the main petroleum products are:

- Liquefied petroleum gases (LPG): these gases mainly include propane and butane
- Gasolines: Regular gasoline – Premium fuel and Unleaded premium fuel – Aviation gasoline
- Diesel
- Jet fuels: intended to power the burners of aircraft turbojet engines
- Domestic fuel or oil

- Heavy fuel for industrial use.

5. Role of specialty in the oil and gas industry

- Data analysis and processing in addition to initial training in Process Engineering
- Identifies and manages specific problems related to Process Engineering within a company or to offer a diagnosis and decision support regarding operations within a company.
- This field requires general multidisciplinary skills, more specific skills, and much more specialized skills allowing the resolution of concerted problems.
- Taking into account complementary methodologies (theoretical and experimental approaches, multidisciplinary projects)

Chapter III Concept on hygiene and safety

1. Definition

Safety is a set of rules and technical and hygiene means. It is a state of mind whose purpose is to create certain working conditions that eliminate dangers. Therefore the presence of a security service in companies is essential to monitor protection, hygiene, fire fighting and represent a system of measures intended to perfect production processes.

Safety studies the industrial dangers of accidents, occupational diseases and develops methods for reducing, preventing and distributing accidents.

2. Objectives of the security service

Labor protection presents a vast system of measures intended to safeguard the moral and physical health of the worker; for this it is necessary to perfect production processes and create safe working conditions.

The security service must be able to ensure:

- Labor legislation (laws)
- Safety technology
- Work hygiene
- Protection against fires

3. Role of security technology

The security technique aims to create:

- Safety devices protect personnel against electrical risks
- Devices protect machinists against moving parts of machines
- Devices protect the environment against harmful and dangerous gases:

4. The main tasks of the hygienist

The hygienist is called upon to resolve problems posed by:

- Noise
- the cold

- Heat
- Humidity
- abnormal pressure
- Vibrations
- Radiation
- lack of lighting
- psychological tensions

A. To understand

- Design criteria and performance limits of suction systems
- Common causes of explosions and fires and appropriate prevention and response techniques
- The difference in concept between toxicity and toxic risk (any product can be manufactured and used safely despite its toxicity)

B. To expect

- Production problems or safety problems occurring when a dangerous or toxic substance escapes due to wear of equipment (valve, pump, reactor)
- Dangerous situations caused by electricity, reactors, occasional operations.

C. Assess

The risks posed by atmospheric pollutants and therefore choosing the appropriate instrumentation

D. Interpret

The data collected and, if necessary, provide effective means of general and individual prevention.

5. The causes of a danger

The major causes which can cause danger are:

- The increase in the size of production units, which has the following consequences:
- Large storage areas
- Considerable tonnages transported
- The diversity of products and increase in their dangerous characteristics
- The operating conditions of the units close to their limits to improve their performance
- Urbanization around the sites which:
    - Increase the power of nuisance
    - Worsen the consequences of accidents

6. Potential dangers of the industry

- Explosions (deflagration-detonation)
    - Gas and vapor explosion
    - Explosion of powders and dust
    - Thermal explosion
    - Physical explosion
- Combustion and fires
    - Dust
    - Layers of powdery products
    - Gases and vapors
    - Liquids
- emissions