Lecture 1

1.1. The difference between classical and industrial chemistry

• The exploitation of materials and energy in appropriate scale

• Application of science and technology to enable humanity experience the benefits of chemistry in areas **such as food production, health and hygiene, shelter, protection, decoration, recreation and entertainment.**

1.2. Classification of the Manufacturing Industry

Manufacturing industry is a compartment of industry or economy which is concerned with the production or making of goods out of raw materials by means of a system of organized labour.

Manufacturing industry can be classified into two major categories namely, **heavy and light industry.**

1.2.1. Manufacturing sub-sectors

1.3. The Chemical Industry

1.3.1. The Structure of the Global Chemical Industry

We normally put a value to something according to how much it has cost us. Some things are of high value while others are of low value. For low valued products, you need to produce them in large volumes to make significant profit. This means that the raw materials are cheap and easily accessible. There is also an existing, relatively simple, and easily accessible processing technology. To sell a large volume of product, there must be a large market. This brings stiff competition which also makes the price to remain low.

1.3.1.1. Commodity Chemicals

The global chemical industry is founded on basic inorganic chemicals (BIC) and basic organic chemicals (BOC) and their intermediates. Because they are produced directly from natural resources or immediate derivatives of natural resources, they are produced in large quantities. In the top ten BIC, almost all the time, sulphuric acid, nitrogen, oxygen, ammonia, lime, sodium hydroxide, phosphoric acid and chlorine dominate. The reason sulphuric acid is always number one is because it is used in the manufacture of fertilizers, polymers, drugs, paints, detergents and paper. It is also used in petroleum refining, metallurgy and in many other processes. The top ranking of oxygen is to do with its use in the steel industry. Ethylene and propylene are usually among the top ten BOC. They are used in the production of many organic chemicals including polymers. BIC and BOC are referred to as commodity or industrial chemicals. Commodity chemicals are **therefore** defined as low-valued products produced in large quantities mostly in continuous processes. They are of technical or general purpose grade.

1.3.1.2. Specialty Chemicals

High-value adding involves the production of small quantities of chemical products for specific end uses. Such products are called specialty chemicals. These are high value-added products produced in low volumes and sold on the basis of a specific function. In this category are the so-called **performance chemicals** which are high value products produced in low volumes and used in extremely low quantities. They are judged by performance and efficiency. Enzymes and dyes are performance chemicals. Other examples of specialty chemicals include **medicinal chemicals, agrochemicals, pigments, flavour and fragrances, personal care products, surfactants and adhesives**. Specialty chemicals are mainly used in the form of formulations. Purity is of vital importance in their formulation. This calls for organic synthesis of highly valued pure chemicals known as **fine chemicals.**

1.3.1.3. Fine Chemicals

At times you will find that the raw materials for your product need to be very pure for the product to function as desired. Research chemicals are in this category as also are pharmaceutical ingredients. Such purified or refined chemicals are called fine chemicals. By **definition** they are high value-added pure organic chemical substances produced in relatively low volumes and sold on the basis of exact specifications of purity rather than functional characteristics. The global market share for each type is roughly as follows:

Commodities 80%

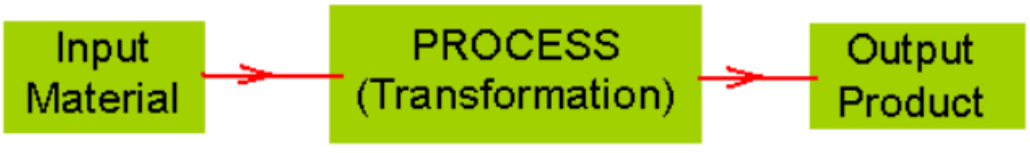
Specialties 18%

Fine 2%.

1.4. Raw material for the Chemical Industry

1.4. Chemical Processes

Chemical Processes Every industrial process is designed to produce a desired product from a variety of starting raw materials using energy through a succession of treatment steps integrated in a rational fashion. The treatments steps are either physical or chemical in nature.



A Typical Industrial Process

In Table 1, examples of some unit processes are given.

Acylation	Calcinations	Dehydrogenation	Hydrolysis
Alcoholysis	Carboxylation	Decomposition	Ion Exchange
Alkylation	Causitization	Electrolysis	Isomerization
Amination	Combustion	Esterification	Neutralization
Ammonolysis	Condensation	Fermentation	Oxidation
Aromatization	Dehydration	Hydrogenation	Pyrolysis

1.4.1.2. Unit Operations

Agitation	Dispersion	Heat transfer
Atomization	Distillation	Humidification
Centrifuging	Evaporation	Mixing
Classification	Filtration	Pumping
Crushing	Flotation	Settling
Decanting	Gas absorption	Size reduction

1.5. Flow Diagrams

Fig. 1.1 is an example of a block diagram.

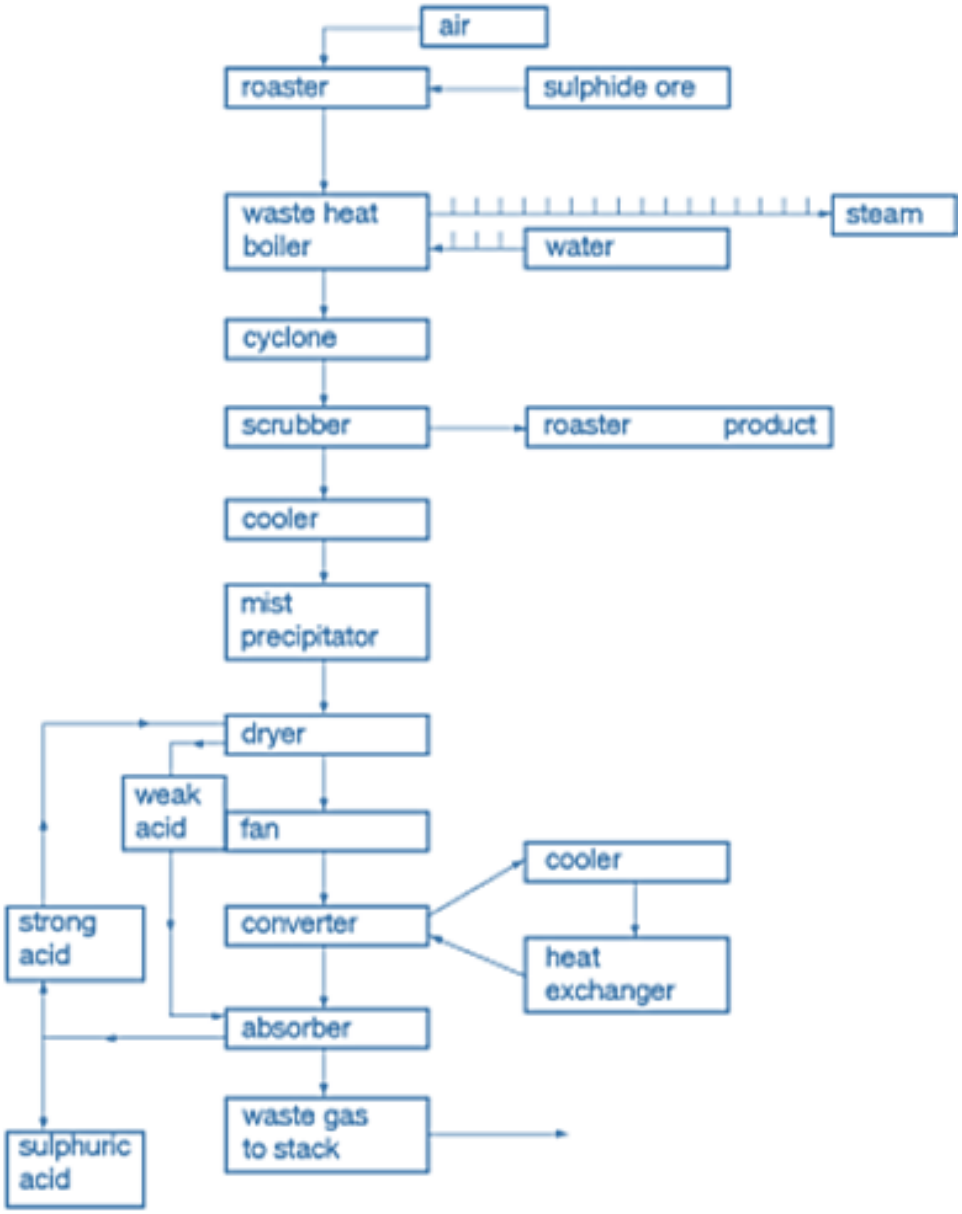


Fig 1.1 A block diagram for a sulphuric acid plant

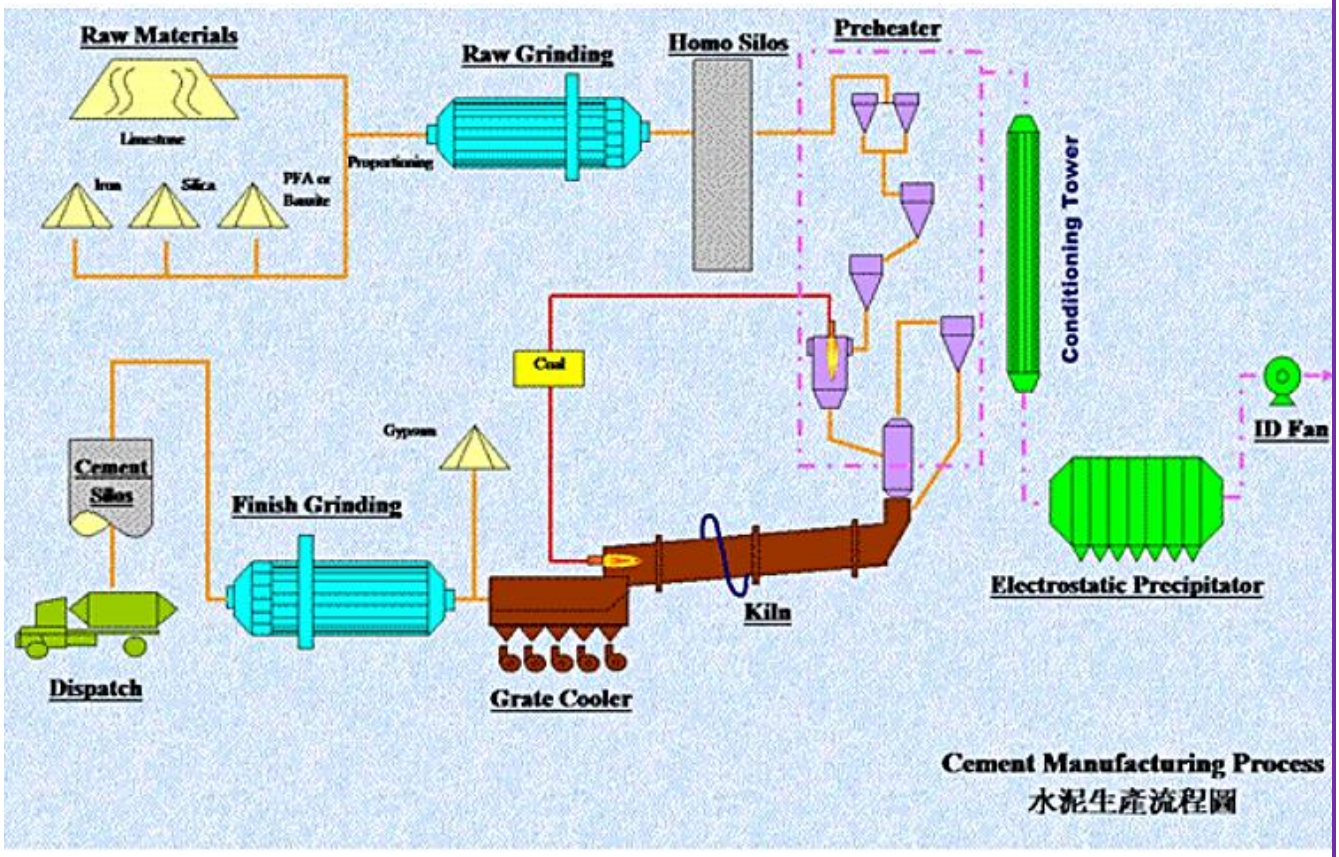


Fig 1.2 A process flow diagram for the manufacture of cement.