

## Jay Shri Harsiddhi mataji

### Syllabus

Module No.	Lecture Numbers	Topics to be covered
<b>Module No. 1</b>	<b>1 – 4</b>	<b>Overview</b>
		Introduction, classification of chemical industries, material of construction, process instrumentation, safety, fire protection and waste disposal
<b>Module No. 2</b>	<b>5 – 10</b>	<b>Acid industries</b>
		Manufacture, history ,properties and uses of acetic acid, formic acid, benzoic acid, phthalic acid and oxalic acid
<b>Module No. 3</b>	<b>10 – 19</b>	<b>Fermentation industries</b>
		Introduction, culture development, inoculums preparation, nutrients for microorganism, toxic effects on culture. Manufacture, properties and uses of Industrial alcohol, absolute alcohol, butyl alcohol, glycerol, ethylene glycol and propylene glycol
<b>Module No. 4</b>	<b>20 – 23</b>	<b>Industrial sodium compounds</b>
		Manufacture, properties and uses of sodium thiosulfate, sodium bromide, sodium sulfate and sodium sulphite
<b>Module No. 5</b>	<b>24 – 31</b>	<b>Halogens and chlorinated compounds</b>
		Introduction, manufacture, properties and uses of fluorine, bromine, iodine, chlorine, methyl chloride, dichloromethane, chloroform and carbon tetrachloride
<b>Module No. 6</b>	<b>32 – 35</b>	<b>Electro-thermal industries</b>
		Introduction, classification and advantages of electric furnace. Manufacture of silicon carbide, calcium carbide, graphite and carbon electrodes
<b>Module No. 7</b>	<b>36 – 40</b>	<b>Industrial solvents</b>
		Synthesis and properties of dimethylformamide (DMF), dimethyl sulfoxide (DMSO), tetrahydrofuran, dimethyl ether and diethyl ether

**Module: 1**  
**Lecture: 1**  
**OVERVIEW**

**INTRODUCTION**

The activities of chemical process industries are divided into two parts, one is synthesis of new products and the other is separation or purification of synthesized products. A manufacturing unit is concerned with industrial processes in which raw materials are processed or separated into useful products. In some case, the products themselves may serve as the starting materials for other industries or product, in other words they may not be the end products and are called as the intermediates.

Chemical industries are basically divided into two groups.

First which produces simple compounds from the locally available large amount of raw materials usually they are very large industries and the product manufactured are purified to the extent that they can be used as raw material for other industries or they are directly marketed as a consumer goods. In general they are heavy chemical industries.

On the other hand certain industries deal with speciality chemicals and they are making small quantity of product having better quality which is sold into market as finished good. They are called as fine chemical industries.

**CLASSIFICATION**

The materials used or produced in the chemical industries are classified in the following manner.

**1. Quantity of production and consumption**

**a) Heavy chemicals**

Those dealt in large quantity normally crude or less purified chemicals.  
E.g. Mineral acid, NaOH, Na<sub>2</sub>CO<sub>3</sub> etc.

**b) Fine chemicals**

They are completely purified substances and produced in limited quantity.

E.g. Speciality solvents, perfumes, medicines etc.

**2. Chemical composition**

**a) Organic compound**

Compounds having carbon atom in the main structure of the molecule is called organic compound.

E.g. Hydrocarbons, phenols, carboxylic acid etc.

**b) Inorganic compound**

They are the compounds, which do not have carbon in the main structure.

E.g.  $\text{Na}_2\text{CO}_3$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ ,  $\text{MgCl}_2$ .

**c) Polymers**

They are the macromolecular mass compounds made from covalent bonding of repeating structured units which may be natural, synthetic or semi synthetic.

E.g. Polystyrene, polyvinylchloride etc.

**3. Based on availability**

**a) Natural compounds**

Compounds which are available in nature or produced or extracted from plant and animals are referred as natural products. Due to large utilization & limited production the natural source is depleting. E.g. coal, petroleum etc.

**b) Synthetic products**

Man made compounds are referred as synthetic products. They may be synthesized using natural product or they are synthesized completely using other type of synthetic materials. Such product is suited to direct applications.

E.g. Polystyrene, polyvinylchloride etc.

#### 4. Based on application

##### a) Catalyst

A substance, usually used in small amounts relative to the reactants, that either increases or decreases the rate of a reaction without being consumed in the process. If consumed then it should be regenerative at the end of process.

E.g.  $\text{AlCl}_3$ ,  $\text{MnO}_2$ , Pt etc.

##### b) Bulk drug

Bulk drug is the active substance used in a drug formulation. It becomes an active ingredient of the finished dosage form of the drug, but the term does not include intermediates used in the synthesis of such substances.

E.g. Pantoprazole, bisacodyl etc.

##### c) Resin

Resin is a natural or synthetic compound which begins in a highly viscous state and hardens with treatment.

E.g. Urea formaldehyde, epoxy, polyester etc.

##### d) Dyes and Pigments

A dye or a dyestuff is usually a coloured organic compound or mixture that may be used for imparting colour to a substrate such as cloth, paper, plastic or leather in a reasonably permanent fashion.

Pigments are defined as colouring agents that are practically insoluble in the application medium, whereas dyes are colouring agents that are soluble in the application medium.

Many organic pigments and dyes have the same basic chemical structure. The insolubility required in pigments can be obtained by excluding solubilizing groups, by forming insoluble salts (lake formation) of carboxylic or sulfonic acids, by metal complex formation in compounds without solubilizing groups, and particularly by incorporating groups that reduce solubility (e.g. amide groups) e.g. cadmium yellow, cobalt blue, zinc white, phthalo green, phthalo blue, titanium yellow and carbon black.

**e) Solvent**

A liquid in which substances (or solutes) are dissolved to form a solution is called as solvent.

E.g. Benzene, THF, DMF, DMSO etc.

**f) Miscellaneous**

All other compounds which do not cover in above class are called as miscellaneous.

E.g. Fertilizer, glass etc.

**Material of construction**

The appropriate selection of material of construction is the initial step toward controlling hazards in the chemical industry. The selection of material of construction depends on the types of the chemical to be stored or processed. The suitable material of construction for equipment or process is tabulated in table 1.

Sr. No.	Storage or process	Suitable material
1	Caustic soda solution (50 %)	Monel (alloy of nickel and copper)
2	Brine (15% concentration)	Monel (alloy of nickel and copper)
3	Brine, saturated	Concrete tank
4	Chlorination of benzene	Lead or glass
5	Polymerization reactor	Stainless steel or glass lined vessel
6	Caustic soda	Steel, nickel
7	Chlorine - Dry - Dry or wet	Iron or steel, copper High silicon iron, silicon rubber and Teflon
8	Urea autoclave	Stainless steel
9	Oleum	Steel power
10	HCl	Teflon, steel rubber lined PTEE and porcelain
11	HNO <sub>3</sub> - Aqueous concentrated - Concentrated at 100°C	SS, aluminium or Chromium alloys High silica iron, Kel-F
12	H <sub>2</sub> SO <sub>4</sub> - to absorb SO <sub>3</sub> - Pipes for 95% - Pipes for dilute	Packed steel tower lined with acid proof bricks Cast iron Lead
13	SO <sub>3</sub> absorber	Chemical stoneware

14	Ammonia - Anhydrous - Liquid	MS Steel container
15	CCl <sub>4</sub>	SS, tin, high silicon iron (14% Si)
16	Alkaline solution	Nickel
17	Pressure vessel operating at 500atm and 500°C	Molybdenum SS
18	To pump caustic soda, chlorinated brine on hypochlorous acid	Rubber lined pumps
19	Rotary dryers	MS
20	Coke oven - Wall lining - Regenerators	Silica bricks Fire clay bricks
21	Fermenter to produce ethanol from molasses	Copper bearing steel
22	Reactor to produce PVC	Nickel or glass lined steel
23	Protection from rusting	GI sheet
24	Fluorine, dry	Copper vessel