

Chapter # 11

Industrial

Chemistry



Industrial chemistry is the branch of chemistry which deals with the conversion of raw materials into useful product through chemical process.

INTRODUCTION TO CHEMICAL INDUSTRIES

"The term chemical industries refers to all those companies that manufacture chemicals".

Some well-established chemical industries are given below;

(i) Petrochemical Industries:

These industries are primarily focuses on the extraction, refining and processing of petroleum and natural gases.

They also produce many other chemicals as by products which then sold as a raw materials several useful substances.

(ii) Fertilizer Industries:

Fertilizer industries are responsible for the production of fertilizers, which are substances used to improve soil fertility and promote plant growth. Fertilizers provide essential nutrients to plants, enhancing crop yields and agricultural productivity.

There are two main types of fertilizers: organic fertilizers, which are derived from natural sources, and synthetic fertilizers, which are manufactured chemically.

Some common synthetic fertilizers are listed

Synthetic Fertilizer	Chemical Formula	Nutrients Provided	Uses
Ammonium Nitrate	NH_4NO_3	Nitrogen	Development of roots and maintaining pH soil
Urea	$\text{CONH}_2)_2$	Nitrogen	Development of leaf, steam and fruits
Diammonium Phosphate(DAP)	$(\text{NH}_4)_2\text{HPO}_4$	Nitrogen, Phosphorus	Development of early stage of plants growth
Potassium Chloride(MOP)	KCl	Potassium	Help enzyme activities and photosynthesis

(ii) Textile Industries:

Textile industries are sectors of the economy that involve the production of fabrics and textiles, including natural fibers like cotton and wool, as well as synthetic materials like polyester and nylon.

These industries play a vital role in providing a wide range of products, from clothing and household items to industrial materials

Synthetic Textile Products	Description	Uses
Polyester	A synthetic fiber made from petrochemicals	Clothing (shirts, pants, dresses, jackets), curtains, bedding etc.
Nylon	A strong and durable synthetic fiber	Stockings, hosiery, swimwear's, ropes, parachutes, and various sportswear's.
Acrylic	A soft and light weight synthetic fiber.	Sweaters, blankets, faux fur, carpets,

(iv) Paint Industries:

The paint industry is a sector that produces liquid or powdered substances used for coating surfaces, providing protection, decoration, and other functional purposes in various applications such as construction, automotive, and industrial sectors.

Paint Products	Description	Common Uses
Water-Based Paint	It is also known as latex. In this paint water is used as a carrier solvent	Interior and exterior walls, ceilings, and various surfaces.
Oil-Based Paint	It contains organic solvents as a carrier.	Woodwork, metal surfaces and surfaces that require durability.
Enamel Paint	A type of oil-based or water-based paint with a hard, glossy finish.	Metal surfaces, kitchen appliances, and surfaces that need high durability.
Epoxy Paint	A two-part paint that consists of a resin and a hardener, creating a tough and durable coating.	Industrial floors, garage floors, marine applications, and metal surfaces.

(v) Detergent Industries:

The detergent industry produces cleaning products, typically containing surfactants and other agents, designed for various applications like laundry, dishwashing, and surface cleaning. These products help to remove dirt, stains, and grease for improved hygiene and cleanliness.

Detergent Products	Composition	Main Uses
Laundry Detergent	Surfactants, builders, enzymes, fragrance, water softeners	Cleaning clothes in washing machines
Dishwashing Detergent	Surfactants, enzymes, fragrance, water softeners	Washing dishes by hand or in dishwashers
All-Purpose Cleaner	Surfactants, solvents, fragrance, water	Cleaning various surfaces and floors
Hand Soap	Surfactants, moisturizers, fragrance, antibacterial agents	Hand hygiene and cleansing

(vi) Cement Industries:

The cement industry involves the production of cement, a binding material used in construction, made primarily from limestone, clay, and other raw materials. Cement is a fundamental component of concrete and mortar, essential for building infrastructure and structures worldwide.

Cement Type	Composition	Main Applications
Ordinary Portland Cement (OPC)	Clinker (mainly composed of calcium silicates), gypsum, limestone, and small amounts of concrete and production. other materials.	Infrastructure construction,
Portland Slag Cement (PSC)	Clinker, slag, gypsum and limestone.	Underground construction marine works, and sewage works.
White Cement	Clinker, limestone, and gypsum with low iron content.	Tile grout and other decorative constructions.

PHARMACEUTICAL INDUSTRY

Pharmaceutical industries refers to the companies where drugs are manufactured.

“Drug is a substance that is used to treat or cure a disease in human or animals”.

Classification of pharmaceutical products is based on various factors, such as chemical structure, mechanism of action, therapeutic use and biological activities. Some common drugs are described below.

Analgesics

"A drug that specifically targeted on central nervous system to provide pain relief without consciousness is known as analgesic drug".

"Asprin" is the oldest and the most common analgesic drug.

Antibiotics

This drug is produced from certain chemicals of microorganism.

"It suppress growth or kills microorganisms".

"Penicillin" was the first discovered antibiotic. Now a days a range of antibiotics are used depending upon doctors prescription.

Antipyretic medicines

*A drug which lower the body temperature to normal is known as antipyretic".

The most widely used antipyretic medicine is "paracetamol".

Anti fungal medicine

"These drugs use to kill fungi that cause infections on skin".

The most common skin infections are ringworm and dandruff. Example of antifungal drug is "fluconazole".

Anti inflammatory medicine

"These drugs helps reduce inflammation, and relieve pain".

Ibuprofen (Brufen) is an example of anti inflammatory medicine. However many other options are also available.

Anti allergic medicine

These are also called antihistamines. Histamine is a chemical produce in the body due to decarboxylation of an amino acid known as histidine.

"The administration of these drugs reduces the histamine level in the body".

A wide range of anti-allergic medicines are available in the market, one example of anti-allergic medicine is diphenyl hydramine".

Anti malarial medicine

Anti protozoal or anti-Malarial drugs are use to treat mosquito bite infectious diseases such as malaria. Most commonly used anti material drug is chloroquine.

There are hundreds of pharmaceutical industries operating in Pakistan.

Health ministry of Govt. of Pakistan play important role in the availability and accessibility of drugs in public sector.

PESTICIDES

"Chemical which are used to control, repel or kill pests or insects or fungus are known as pesticides".

Types of Pesticides

Pesticides are classified into three major classes named as insecticides, fungicides and herbicides.

Insecticides

"Chemical substances which use to kill insects are called as insecticides". The best known insecticide is Dichlorodiphenyltrichloroethane (DDT),

Herbicides

Undesirable herbs often co-exist with crops creating problems for the growth and fertility of crops, by taking away their share of nutrient water and sunlight, these types of herbs are known as weeds. "Herbicides are the chemicals which either destroy or stop growing weeds". A very common herbicide which farmer prefer to use is 2,4-dichlorophenoxyacetic acid (abbreviated as 2, 4-D).

Fungicides

"Fungicides are chemical substances employed to eliminate undesired fungi that develop within crops". A very common fungicide Mancozeb (Manganese ethylenebis (dithiocarbamate) zinc salt) which is used to control various fungal diseases on crops like potatoes, tomatoes, and grapes.

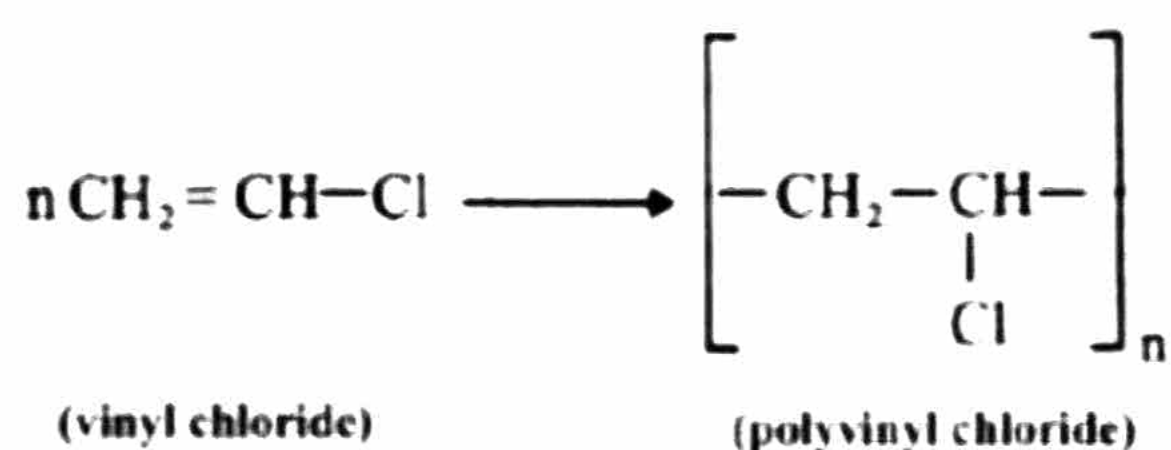
SYNTHETIC POLYMERS

"Polymer is a high molecular mass compound that forms by the combination of a large number of one or more types of molecules of low molecular mass". Polymers are either obtained from natural source such as rubber, cellulose, starch, etc or synthesized by chemical reactions.

Another classification of synthetic polymers is based on their behavior on heating. Thermoplastics soften on heating and regain their original properties on cooling, whereas thermosetting plastics undergo irreversible transformation, becoming hard and rigid upon heating.

Polyvinyl chloride (PVC)

Polyvinyl chloride (PVC) is a widely used thermoplastic due to its versatility and durability. It is known for its excellent electric insulation, light weight and low cost. PVC is an addition polymer of vinyl chloride it is prepared by heating vinyl chloride at 60-70°C in the presence of Hydrogenperoxide (H_2O_2).

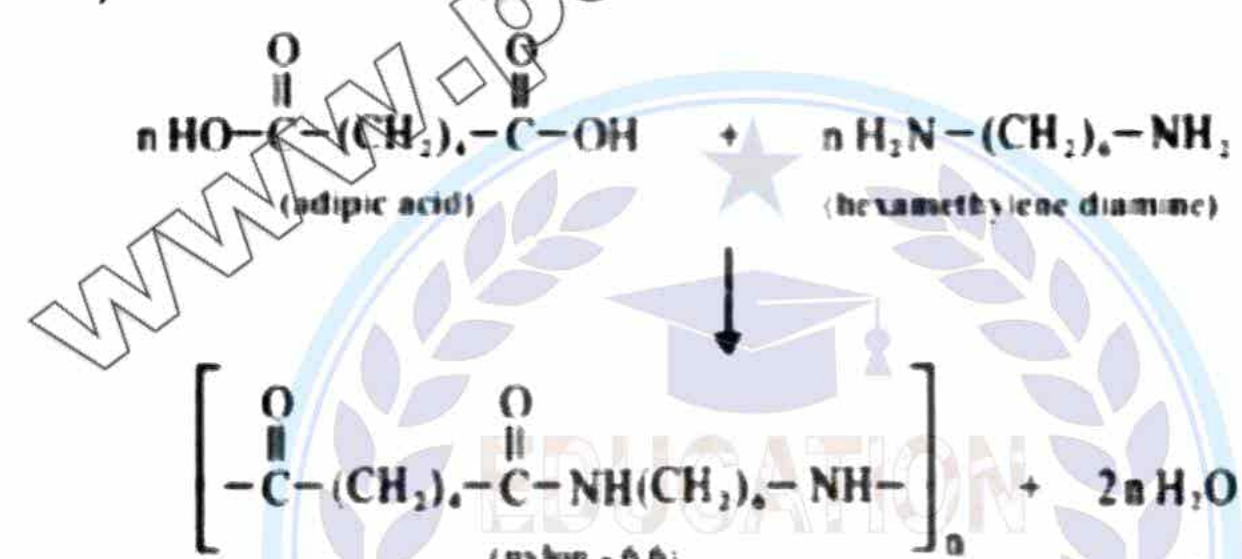


PVC is used in the manufacturing of bottles, pipes, medical tubes, blood bags and insulation material on electric wires.

Nylon 6, 6

Nylon 6, 6 is a type of **synthetic polymer**. It is known due to its high strength, light weight and **excellent mechanical properties**.

Nylon 6, 6 is chemically a polyamide and prepared by the process of condensation polymerization between hexamethylenediamine and adipic acid (hexanedioic acid) with the elimination of water molecules.



Nylon 6, 6 is used in making tents, parachutes, ropes, fish net, bristles of brushes and tires etc



COSMETICS

The word cosmetic is derived from the Greek word "kosmetiko" meaning beautifying complexation of skin.

"Cosmetics are the products that are used to enhance or alter the appearance of face, body, nails or hairs". Thousands of cosmetic products are manufactured in the industries, few very common are briefly described below.

(i) Lipstick:

"Lipstick is a chemical used to colour, moisturization and protection of the lips".

It is a type of makeup that usually available in a stick and is applied directly to the lips. Lipstick is typically made from a mixture of oils, waxes, pigments, fragrance and moistening agent.

(ii) Nail Polish:

It is a type of lacquer that is used to enhance the appearance of nails in women. comes in a variety of colours including red, pink, brown and others. The basic components of nail polish include pigments, resin, plasticizers and film former.

(iii) Nail Polish Remover: It is an organic solvent such as "acetone" along with some other ingredients such as scent.

(iv) Hair Dyes:

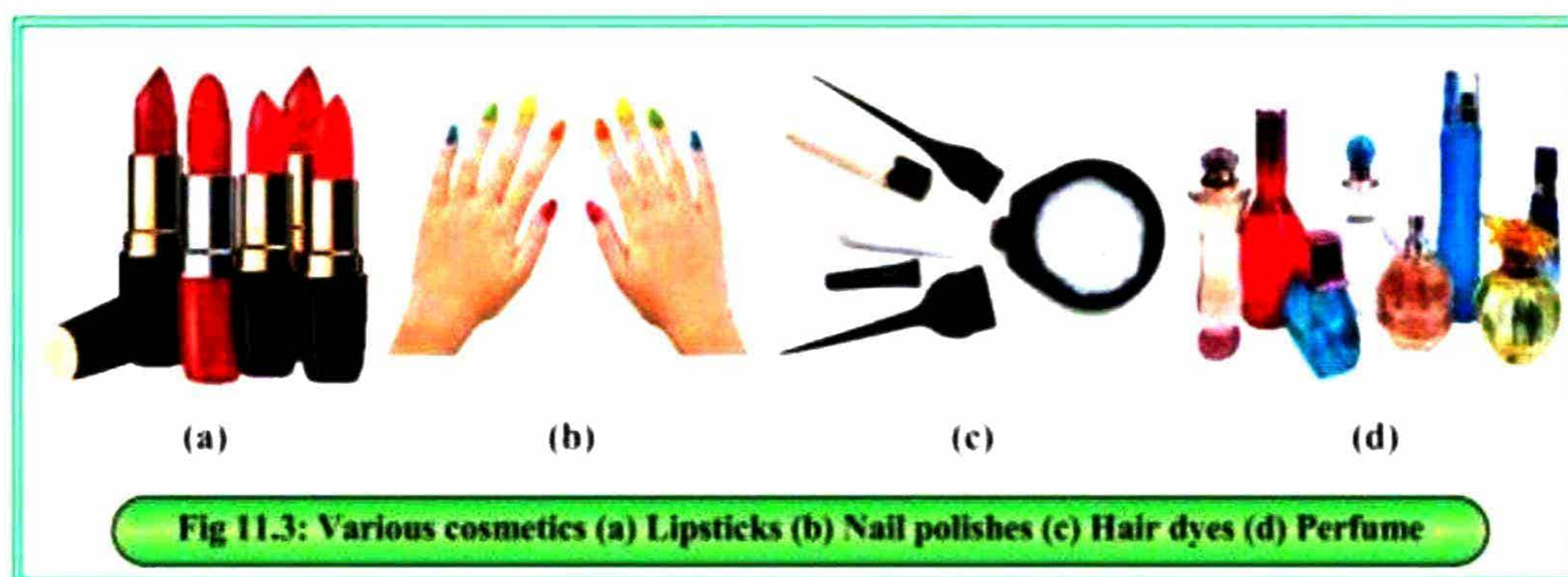
These are chemicals that change the colour of hairs. Hair dyes are classified into temporary and permanent hair dyes.

Temporary hair dye last for a short period of time, typically a few washes. It is available in various form such as spray, gels and shampoos.

Permanent hair dye refers to a coloring product that last for long period of time. It mainly consists of colourant and developer. The developer is an oxidizing agent generally, hydrogen per oxide is used as developer.

(v) Perfumes:

These are complex mixtures of aromatic compounds, solvents, and fixatives that create pleasant and distinctive scents. They typically consist of top, middle, and base notes, which work together to provide a well-balanced and long-lasting fragrance.



ADHESIVES

“Adhesives or glue are chemical substance that use to stick materials together”.

They are liquids or semi solids. They create a bond between the two surface through either physical or chemical processes. A wide variety of adhesive are available, each possessing unique properties and appropriate applications. Some of frequently used adhesive are described below.

Starch

It is a natural adhesive and prepared by heating starch suspension in water. It has low adhesive strength but widely used because it is easily prepared and low cost. Starch is used as a thickening agent in various food products and as a raw material for the production of biodegradable plastics.

Epoxy Resins

These are strong synthetic adhesives and commonly used for bonding metals, plastics, glasses and ceramic items.

Silicon Resins

These are known with their high strength, high thermal stability and water repellent ability. These are use in sealing of engines, gasket making, bonding of optical instruments and medical instruments.

Super Glue

It is chemically named as cyanoacrylate. It is fast acting adhesive that bond quickly of broken items such as jewellery, toys, automobiles etc.

Wood Glue

It is chemically named as polyvinyl acetate. It is a water based adhesive. It form a strong and durable bond between pieces of woods when compressed them under high pressure.



Short Questions

1. Give the scope of pharmaceutical industries in Pakistan.

1. Pharmaceutical Industry in Pakistan:

The pharmaceutical industry in Pakistan is a significant contributor to the country's healthcare sector. Here's a general overview:

- **Market Size and Growth:** The Pakistani pharmaceutical market is estimated to be worth several billion dollars and is experiencing steady growth.
- **Local Production:** A significant portion of the medicines consumed in Pakistan are produced domestically by local pharmaceutical companies.
- **Generic Drugs:** Generic drugs, which are more affordable versions of brand-name medications, form a major segment of the Pakistani pharmaceutical market.
- **Challenges:** The industry faces challenges such as counterfeiting, price control regulations, and competition from imported drugs.

2. What is antihistamine drug? Give the symptoms in which it is used.

2. Antihistamine Drugs:

Antihistamines are a class of medications used to treat symptoms associated with allergies, such as:

- **Runny or stuffy nose**
- **Itchy, watery eyes**
- **Sneezing**
- **Hives**
- **Skin rash**

They work by blocking the action of histamine, a chemical released by the body's immune system during an allergic reaction.

3. Write the names of two synthetic and two natural polymers.

- **Synthetic Polymers:** Examples include:
 - **Nylon:** Used in textiles, clothing, carpets, and engineering applications.
 - **Polyvinyl chloride (PVC):** Used in pipes, tubing, flooring, and building materials.
- **Natural Polymers:** Examples include:
 - **Cellulose:** Found in plant cell walls, used in paper, textiles, and food additives.
 - **DNA:** The genetic material in all living organisms.

4. Write the name of four main components of Nail polish?

Nail polish typically consists of several key components:

- **Film Formers:** These create the hard, protective coating on the nail. Examples include nitrocellulose and various resins.
- **Solvents:** These help dissolve the film formers and allow for smooth application. Examples include acetone, ethyl acetate, and butyl acetate.
- **Plasticizers:** These improve flexibility and prevent the polish from becoming brittle.
- **Pigments and Dyes:** These provide color to the nail polish.

Descriptive Questions

1. How can you define Cosmetics? Describe four cosmetics which are commonly used.

Notes

2. What are pesticides? Explain various types of pesticides along with their specific use.

Notes

3. Describe the preparation, properties and uses of Nylon and polyvinyl chloride.

Notes

4. What are adhesives? Explain the significance of super glue and silicon resins.

Notes

