Plastics

- Plastics are high molecular weight organic materials which can be moulded into any desired shape by the application of heat and pressure in the presence of catalyst.

Constituents of plastics:

1. Resins
2. Plasticizers
3. Fillers or Extenders
4. Lubricants
5. Stabilizers
6. Pigments
7. Anti-oxidants
8. Catalysts or Accelerators

Resins:

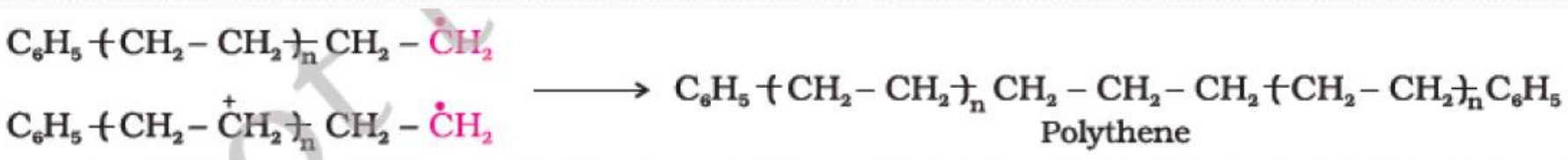
- They are basic binding materials and hold the constituents together.
- They are generally linear polymers with low molecular weight to enhance fusibility and mouldability.
- It is then converted into crosslinked form during moulding in the presence of a catalyst.
- E.g. Thermoplastic resins and thermosetting resins.

Plasticizers:

- They improve flow for processing by reducing the intermolecular force of attraction
- E.g. Dioctylphthalate, oleate and organic phosphates

Polyethylene(PE)/Polythene

- There are mainly two types of polythene:
- ***Low density polythene***(density range of 0.910–0.940 g/cm^3):It is obtained by the polymerisation of ethene under high pressure of 1000-2000 atm at a temperature of 350-570 K in the presence of traces of oxygen or a peroxide initiator.
- It is created by free radical polymerization.



- **Properties**:

1. High degree of short and long chain branching.
2. intermolecular forces is less.
3. Tough but highly flexible & ductile.
4. Chemically inert.

- **Uses**: Insulation of electricity carrying wires and manufacture of squeeze bottles, toys and flexible pipes.

- ***High density polythene***(density >= 0.941 g/cm^3): formed when addition polymerisation of ethene takes place in a hydrocarbon solvent in the presence of a catalyst such as triethylaluminium and titanium tetrachloride (Ziegler-Natta catalyst) at a temperature of 333-343 K and under a pressure of 6-7 atm.
- **Properties:**

1. low degree of branching(lack of branching is ensured by an appropriate choice of catalyst & reaction conditions).
2. stronger intermolecular forces and tensile strength,
3. Chemically inert.

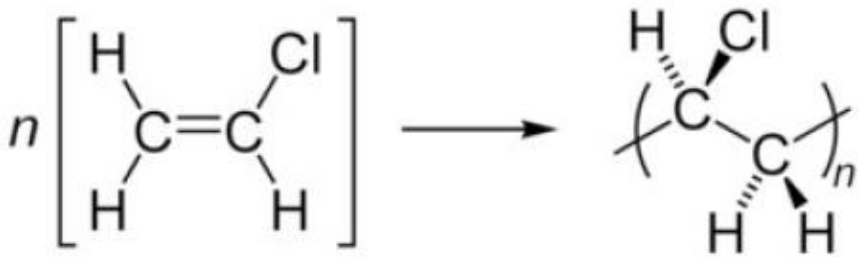
- **Uses**:for manufacturing buckets, dustbins, bottles, water pipes etc.

- **Environmental issue**

  Although polyethylene can be recycled, most of the commercial polyethylene ends up in landfills, and in the oceans such as the Great Pacific Garbage Patch. Polyethylene is not considered biodegradable, except when it is exposed to UV from sunlight. Under UV lights tertiary carbon bonds in the chain structures are the centres of attack. The UV rays activate such bonds to form free radicals, which then react further with oxygen in the atmosphere, producing carbonyl groups in the main chain.

Polyvinyl chloride

- It is a vinyl polymer constructed of repeating vinyl groups (ethenyls) having one of their hydrogens replaced with a chloride group.



- Obtained by heating a water emulsion of vinyl chloride in presence of benzyl peroxide/ hydrogen peroxide in an autoclave under high pressure.

- **Properties**:

1. Colurless & odourless
2. Non-inflammable & chemically inert
3. Resistant to light, O_2, inorganic acid & alkalis.
4. Greater stiffness & rigidity than polyethylene but brittle.

Uses: Third most widely produced plastic

- Unplasticized PVC: Highly rigid but brittle, for making sheets, tank lining, helmets ,mudguards etc.
- Plasticized PVC(by adding plasticizers e.g. phthalates): Making continuous sheets of varying thickness, hoses, pipes, construction, table covers, conveyor belts etc.

BAKELITE, The First Synthetic Polymer

Bakelite, a phenol-formaldehyde polymer, was the first completely synthetic plastic, first made by Leo Baekeland in 1907. Baekeland and an assistant started their research in 1904 looking for a synthetic substitute for shellac.

Bakelite was commercially introduced in 1909. Bakelite was first used to make billiard balls, but, later, was used to make molded insulation, valve parts, knobs, buttons, knife handles, many types of molded plastic containers for radios and electronic instruments, and more.

Properties of bakelite

Phenolic reins set to rigid, hard, scratch resistant, infusible, water resistant, insoluble solids, which are resistant to non-oxidizing acids, salts and many organic solvents, but are attacked by alkalis, because of the presence of free hydroxyl group in their structures, They posses excellent electrical insulating character.

Preparation Of BAKELITE

Phenol - formaldehyde polymers are the oldest synthetic polymers. These are obtained by the condensation reaction of phenol with formaldehyde in the presence of either an acid or a base catalyst. The reaction starts with the initial formation of o-and/or
p-hydroxymethylphenol derivatives, which further react with phenol to form compounds having rings joined to each other through –CH2 groups. The initial product could be a linear product – **Novolac** *used in paints.*

USES OF BAKELITE

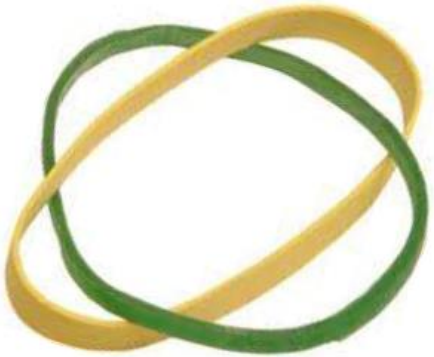
1.Plastic items like telephone parts,cabinets,heater handles.
2.Phonograph records
3.Electrical switches and berings used in propeller shafts in paper industry.
4.Soft bakelite used as binding glue for
laminated,wooden plants and in varnishes
5.Sulphonated bakelite are used as ion exchange resins.
6.For impregating fabrics,wood and paper.

valve parts, knobs, buttons,

Phonograph records

WHAT IS RUBBER...???

- ✓A material that can be stretched and will retract rapidly and forcibly to substantially its original dimensions upon release off the force.



NATURAL RUBBER

- ✓Also known as India Rubber.
- ✓made from milky colloid “LATEX SAP” produced by some plants.
- ✓Latex is natural polymer of isoprene.

LATEX SAP

- ✓Latex is the protective fluid contained in tissue beneath the bark of the rubber tree.
- ✓A cut is made in bark of the tree and latex is allowed to exude into a collecting vessel over a period of hours.
- ✓Latex is processed then dried, sorted and smoked.

TYPES OF RUBBER

➢NATURAL RUBBER

✓A yellowish, amorphous, elastic material obtained from the latex of various tropical plants, especially the rubber tree.

➢SYNTHETIC RUBBER

✓A material with the mechanical property that it can undergo elastic deformation under stress and still return to its previous size without permanent deformation.

NEED OF SYNTHETIC RUBBER

There were a number of reasons responsible for the development of an alternative or substitute for natural rubber. These included:

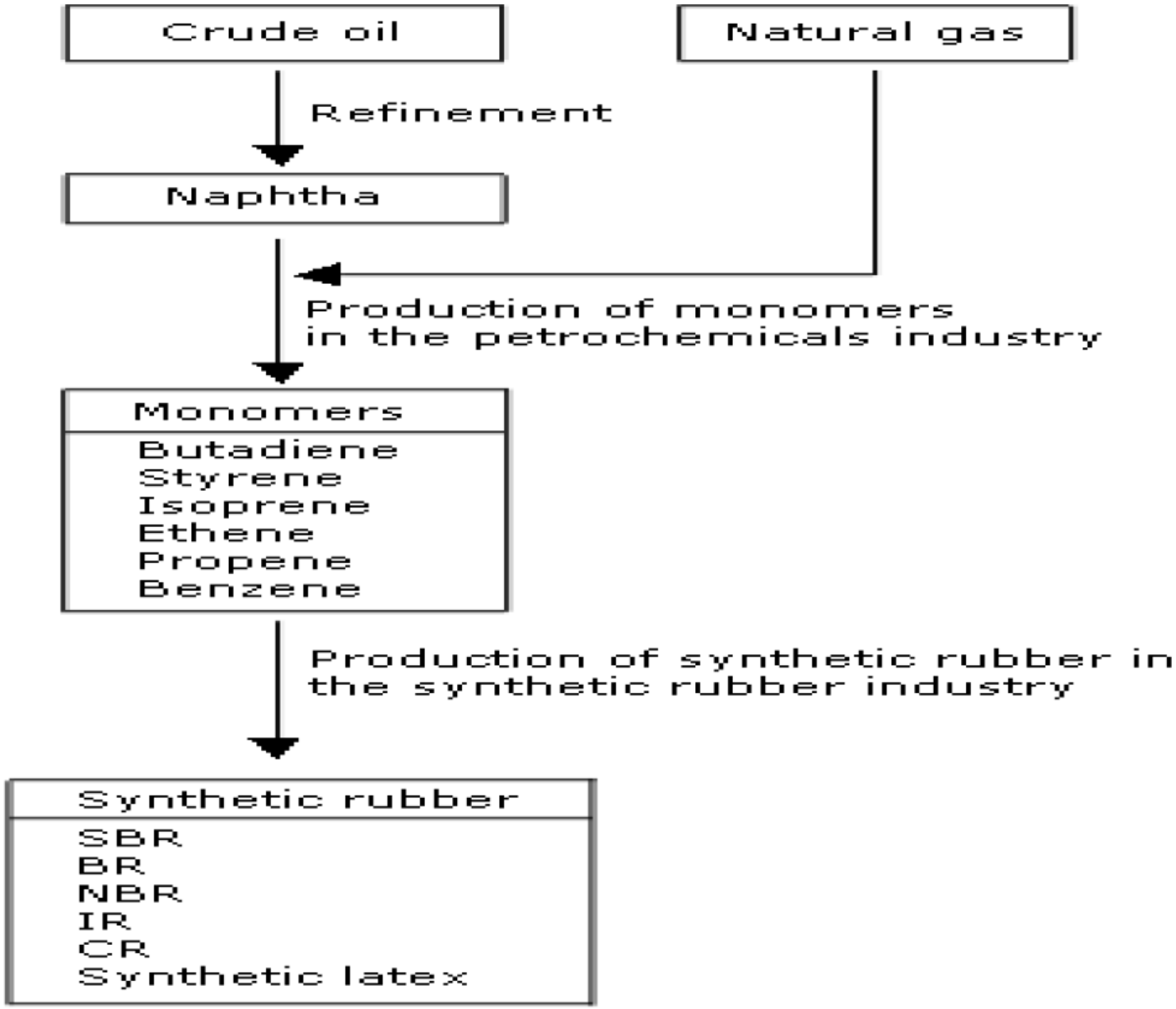
- ✓Volatile or rising prices.
- ✓Supply of raw materials.
- ✓Long transport distances.
- ✓Regional constraints related rubber plantations.
- ✓Increase in global demand for rubber.

DEVELOPMENT OF SYNTHETIC RUBBER

- ✓Synthetic rubber is a white, crumbly, plastic mass which can be processed and vulcanized in the same way as natural rubber.

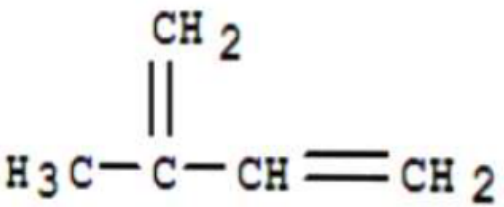
- ✓Most are obtained by polymerization or polycondensation of unsaturated monomers

- ✓Synthetic rubber is produced in different ways. Figure illustrates one of the common production processes.


Crude oil
Natural gas
Refinement
Naphtha
Production of monomers
in the petrochemicals industry
Monomers
Butadiene
Styrene
Isoprene
Ethene
Propene
Benzene
Production of synthetic rubber in
the synthetic rubber industry
Synthetic rubber
SBR
BR
NBR
IR
CR
Synthetic latex

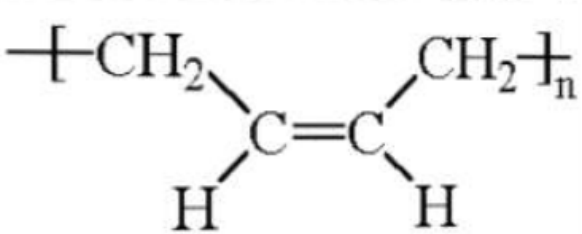
IMPORTANT BREAKTHROUGHS

✓In 1909, Synthetic Rubber, by polymerization of METHYL ISOPRENE by HOFFMANN.



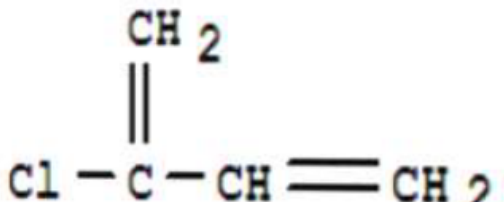
Methyl Isoprene

✓In 1910, Commercial Synthetic Rubber, by polymerizing BUTADIENE.



Polybutadiene

✓In 1931, first successful synthetic rubber, known as NEOPRENE.



Neoprene

PROPERTIES

- ✓Highly amorphous material.
- ✓High randomly orientated structure.
- ✓High tensile strength.
- ✓Low intermolecular forces allow flexibility.
- ✓Energy storing ability.
- ✓Water repellant.
- ✓Resistant to alkalies and weak acids.

ADVANTAGES

- ✓Light Weight.
- ✓Molding.
- ✓High stretch ability and flexibility.
- ✓Resistant to water and other chemicals.
- ✓Electrical Insulation.
- ✓Shock absorbing characteristics
- ✓These are recyclable like plastics.
- ✓They can be easily colored by most types of dyes.

ENERGY STORAGING ABILITY

✓Can store “Elastic Potential Energy” and convert it into “Kinetic Energy” upon the release of applied load.

DISADVANTAGES

- ✓Cold weather hardness.
- ✓Become sticky in damp conditions. That's why, VULCANIZATION is required to make it weather resistant and more durable.
- ✓General inability to bear greater load.
- ✓Heat Absorbency.
- ✓Infectious to skin.
- ✓Relatively high cost of raw materials.

APPLICATIONS OF RUBBER

- Some of the common applications of rubber are:

  - ✓Daily Use Items.
  - ✓Automotive Industry.
  - ✓Adhesive Materials.
  - ✓Sealing Agents.
  - ✓Insulation Material.
  - ✓Sports Goods.
  - ✓Paints and Dyes.
  - ✓Others…

RESIN

INTRODUCTION

Resins are amorphous products of complex chemical nature. They are transparent or translucent solids, semi-solids or liquid substances containing large number of carbon atoms. They are hard, electrically non-conductive and combustible masses. They are usually formed in schizogenous or schizolysigenous cavities or ducts as end products of metabolism.

Most of the resins are heavier than water. They are insoluble in water, but soluble in alcohol, volatile oils, fixed oils, chloral hydrate and non-polar organic solvents like benzene and ether.

The resin produced by most plants is a viscous liquid, composed mainly of terpenes, with lesser components of dissolved non-volatile solids, which make resin thick and sticky. The individual components of resin can be separated by fractional distillation.

The composition of resins varies with the species. The most common terpenes in resin are the bicyclic terpenes, monocyclic terpenes and smaller amount of tricyclic sesquiterpene.

CLASSIFICATION

Based on occurrence, it is classified into five types. They are

1.Oleo resin

2.Gum resin

3.Oleo-gum resin

4.Glucoresin/ Glycoresins

5.Balsam

Based on chemical constituents, it is classified as:

1.Resin Acids/ Resinolic Acids

2.Resin Alcohols/ Resin Esters

3.Resenes/ Inert Resins

METHODS OF EXTRACTION

1. Extraction by using solvents
2. Extraction by Distillation
3. Extraction by making Incisions
4. Extraction by heating the plant part containing resin
5. Extraction of resin from Encrustations

PROPERTIES

1.Physical properties:

(a)Resins in purified form are amorphous, brittle and hard solids.

(b)Their specific gravity is more than one; hence they are heavier than water.

(c)They dissolve in organic solvents.

2. Chemical properties:

(a)Chemically, resins are terpenes.

(b)Resins upon heating soften and melt.

(c)Resins when burnt produce smoky flame

USES

- It reflects light. This decreases the heat on the flowers, thereby protecting them.
- They are used in the preparation of emulsions.
- Solid resenes are available as adhesives.
- They are used externally as mild antiseptic agents in the form of ointments and plasters.
- Animals do not chew the leaves of resinous plants. Hence, they can be used as outdoor plants.
- Resinous drugs possess the action of anthelmintic, counter-irritant, expectorant, hydragogue, laxative, and sedative.