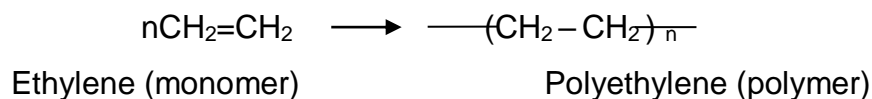




POLYMERS

Polymers are macromolecules (giant molecules of higher molecular weight) formed by the repeated linking of large number of small molecules called monomers.

Example: Polyethylene is a polymer formed by the repeated linking of large number of ethylene molecule.



MONOMER

Monomer is a micro molecule (small molecule) which combines with each other to form a polymer.

Examples:

S.No.	Monomer	Repeating unit in the polymer
1	$\text{CH}_2=\text{CH}_2$ Ethylene	$-\text{CH}_2-\text{CH}_2-$ Polyethylene
2	$\begin{array}{c} \text{CH}_2=\text{CH} \\ \\ \text{CH}_3 \end{array}$ Propylene	$\begin{array}{c} -\text{CH}_2-\text{CH}- \\ \\ \text{CH}_3 \end{array}$ Polyethylene
3	$\begin{array}{c} \text{CH}_2=\text{CH} \\ \\ \text{Cl} \end{array}$ Vinyl Chloride	$\begin{array}{c} -\text{CH}_2-\text{CH}- \\ \\ \text{Cl} \end{array}$ Polyvinyl Chloride (PVC)
4	$\begin{array}{c} \text{CH}_2=\text{CH} \\ \\ \text{CN} \end{array}$ Acrylonitrile	$\begin{array}{c} -\text{CH}_2-\text{CH}- \\ \\ \text{CN} \end{array}$ Polyacrylonitrile (PAN)
5	$\begin{array}{c} \text{CH}_2=\text{CH} \\ \\ \text{C}_6\text{H}_5 \end{array}$ Styrene	$\begin{array}{c} -\text{CH}_2-\text{CH}- \\ \\ \text{C}_6\text{H}_5 \end{array}$ Polystyrene

NOMENCLATURE OF POLYMERS

1. Homo polymer :

- If the polymer chain contains same type of monomer, it is “Homo *polymer*”.

Example : PVC structure: A – A – A- A- A-A -A

2. Hetero polymer :

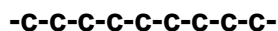
- If the polymer chain contains different type of monomer, it is “*Hetero polymer*”.

Example : Nylon A-B- A-A-A-B-A



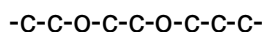
3. Homo chain polymer :

- If the main polymer chain is made up of a same species of atoms, it is called Homochain polymer.



4. Hetero chain polymer :

- If the main polymer chain is made up of a different type of atoms, it is called hetero chain polymer.



CLASSIFICATION OF POLYMERS

- Polymers are mainly classified into two types, based on the source and application.

Based on the 'source', polymers are further classified into three types.

- They are,
 1. Natural polymers
 2. Synthetic polymers and
 3. Semi – synthetic polymers

1. Natural Polymers :

- These are isolated from natural materials like plants and animals
- **Example:** Cellulose, RNA, DNA, proteins (polyamide), rubber, wool and starch, etc.,

2. Synthetic polymers :

- These are synthesized from low molecular weight compounds or materials.
- **Example:** Polyethylene, PVC, polystyrene, terylene, silicones, etc.,

3. Semi – synthetic polymers :

- These are the derivatives of natural polymers.
- **Example:** Cellulose acetate (Rayon), Cellulose nitrate (Gun cotton), Ethyl cellulose, etc.,
- Based on chemical composition (natural and synthetic) polymers are further classified into two major categories.
- They are,
 - i) Organic polymers



ii) Inorganic polymers

i) Organic polymers

- If the polymer backbone chain is essentially made of carbon atoms, it is termed an organic polymer.
- These polymers are containing hydrogen, oxygen, nitrogen and sulphur atoms, attached to the side valences of the carbon atoms

Example: Natural organic polymers – Cellulose, RNA, DNA, proteins, etc.,
Synthetic organic polymers – Polyethylene, PVC, polystyrene, etc.,

ii) Inorganic polymers

- If molecules of polymers contain no carbon atom in their backbone, such polymers are inorganic polymers.
- This type of polymer chain is composed of different atoms joined by chemical bonds.

Example:

- Natural inorganic polymers – Rubber, clay silicates, etc.
- Synthetic inorganic polymers – Glass, silicones, etc.

Based on applications, polymers are broadly divided into three main categories.

1. Plastics (Resins)
2. Fibres (Rayon, terylene) and
3. Elastomers (Rubber)

1. Plastics :

- Plastics are high molecular weight organic materials which can be moulded or formed into stable shapes by the application of heat and pressure.
- All the synthetic polymers are plastics.

2. Fibres

- When a polymer can be converted into long filament like material, it is called fibre.
- **Example:** Rayon and terylene.

3. Elastomers

- Polymers exhibiting good strength and elongation are called elastomers.



- Example: Rubber (Natural rubber, synthetic rubber, etc.,)

PLASTICS

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

Advantages of plastics

- Light in weight.
- Possess low melting point.
- Easily moulded and have excellent finishing.
- Possess very good strength and toughness.
- Possess good shock absorption capacity.
- Corrosion resistant and chemically inert.
- They have low co-efficient of thermal expansion and possess good thermal and electrical property.
- Very good water-resistant and possess good adhesiveness.

Disadvantages of plastics

- Softness.
- Embrittlement at low temperature.
- Deformation under load.
- Low heat-resistant and poor ductility.
- High combustibility.
- Degrade upon exposure to heat and uv-radiation.
- Non bio-degradable.

CLASSIFICATION OF PLASTICS

1. Based on usage
2. Based on structure

1. Classification of plastics based on usage

(i) General purpose plastics

- General purpose plastics have low to medium mechanical properties.
- They are used for manufacture of commodity items.



- They account for 80-85% of the total polymer production.

Properties of general purpose plastics

- low use temperature therefore cannot be used at high temperature
- low abrasion resistance and poor dimensional stability
- They are mostly crystalline with low glass transition temperature (T_g) (or) they are glossy (or) amorphous polymer

2. Engineering plastics

- Engineering materials are a group materials obtained from high polymer resin
- They are mainly used to replace conventional material like metal, wood, glass and ceramics.
- Not only engineering plastics can replace metals but they can also be used along with metals.