



## 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 (Guncotton), 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, clays, 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 coefficient 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 of 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.

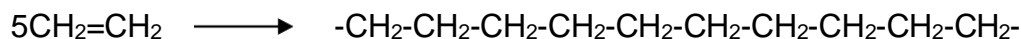
## POLYMERISATION

Polymerisation is a process in which large number of small molecule (called monomers) combine to give a big molecule (called a polymer) with or without elimination of small molecules like water.

### Degree of polymerization

The number of repeating units (n) in a polymer chain is known as the **degree of polymerisation**.

#### Example:



In this example, five repeating units are present in the polymer chain. So the degree of polymerisation is 5.

Degree of polymerisation =  $180/36 = 5$ . So the degree of polymerisation is 5.

$$\left. \begin{array}{l} \text{Degree of} \\ \text{Polymerisation (DP)} \end{array} \right\} = \frac{\text{Molecular weight of the polymeric network}}{\text{Molecular weight of the monomeric unit}}$$

Based on the molecular weight or degree of polymerization, the polymers are reclassified into following types

#### (i) Oligo Polymers:

- Polymers with low degree of polymerisation are known as oligo polymers, their molecular weight ranges from 500-5000 Daltons.

#### (ii) High Polymers:

- Polymers with high degree of polymerisation are known as high polymers, their molecular weight ranges from 10,000 - 2,00,000 Daltons.