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 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.

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:

$$5CH_2{=}CH_2 \longrightarrow -CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}\ CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}$$

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

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

$$\text{Degree of Polymerisation (DP)} = \frac{\text{Molecular weight of the polymeric network}}{\text{Molecular weight of the monomeric unit}}$$

Based on the molecular weight or degree of polymerization, the polymers are classified 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**.**