# Polymer

Polymers are defined as high molecular mass macromolecules which are formed by joining of repeating structural units derived from the appropriate monomers.

## Monomer( mono means single mer means unit)

The unit molecules that combine with each other to form a polymer (**poly means many mer means unit**) is called a monomer.

### Polymerisation

The process of formation of polymers from respective monomers is called polymerisation.

For example:


## Classification of Polymers

***On the basis of source polymers can be divided into the following types:***

**Natural polymers**: These are the polymers that exist in nature,i.e. are found in plants and animals.

For example: Starch, cellulose, rubber, silk.

**Semi-synthetic polymers**: These are polymers that are prepared by making some modification in natural polymers by artificial means, in laboratory.

For example: Rayon the starting material is naturally occurring cellulose.

**Synthetic polymers**: These are the man-made polymers,i.e., the polymers that are prepared in laboratory.For example: Bakelite, Teflon, PVC, polystyrene, nylon.

## *On the basis of structure, polymers can be categorized into the following types:*

**Linear polymers**: These are the polymers in which the monomer units are linked to one another to form long and straight chains.
These chains are closely packed in space which causes the linear polymers to have high densities, tensile strength and high melting and boiling points.
For example: High density polythene (HDPE), PVC, nylon, polyester.

**Branched chain polymers**: These are the linear chain polymers having some branches.

Branching causes these polymers to be loosely packed in space due to which thay have low densities, low tensile strength as well as low melting and boiling points. For example: Low density polythene (LDPE), amylopectin,

**Cross-linked or network polymers**： These are the polymers formed of various linear polymers connected to each other by strong covalent bonds.

These are polymers hard, rigid and brittle.

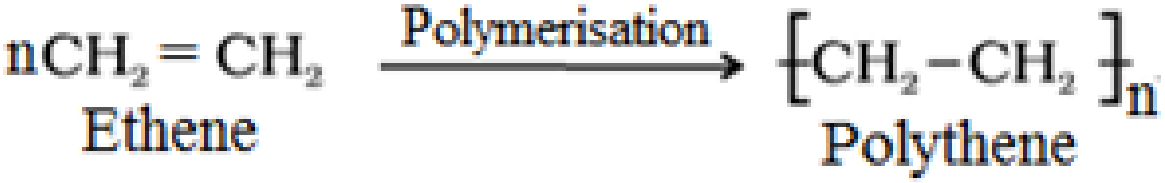
For example: Bakelite, formaldehyde polymer, glyptal, melamine-formaldehyde polymer.

***On the basis of mode of polymerization, polymers are of following two types:***

**Addition polymers:** These are the polymers formed by the repeated addition of monomer molecules containing multiple bonds.

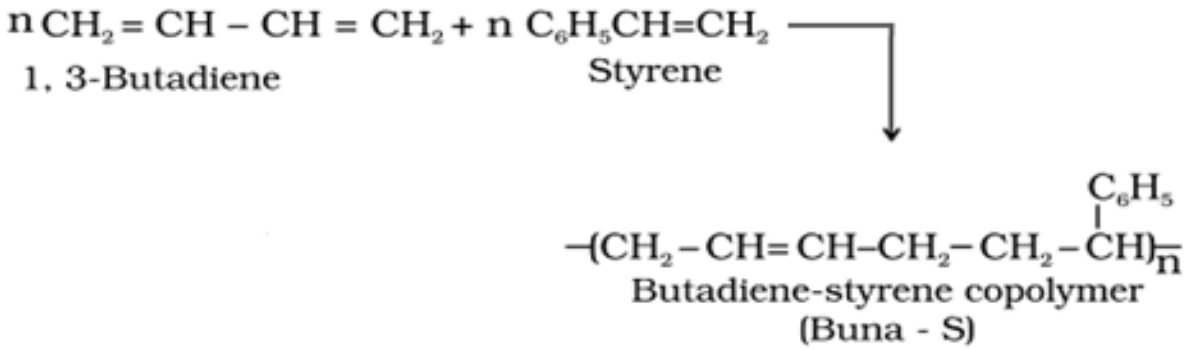
(i) **Homopolymers:** These are the polymers derived from the polymerisation of only one kind of monomers.

For example:



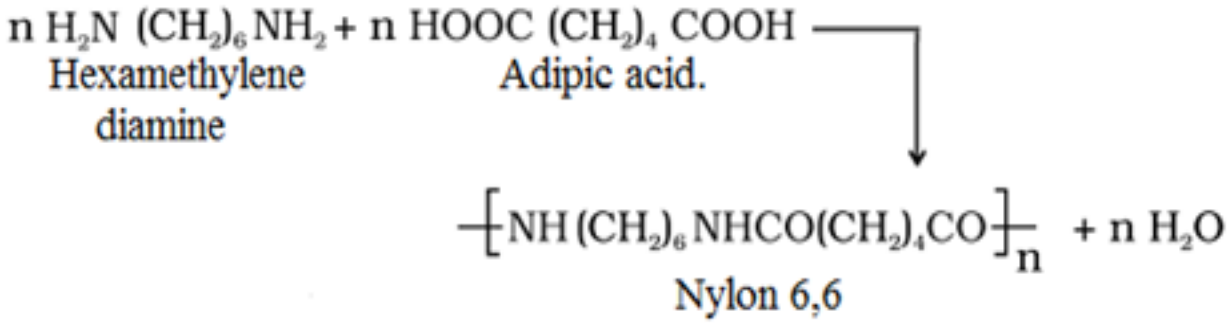

ii) **Copolymers:** These are the polymers obtained by the polymerisation of two or more different kind of monomers.

For example:




- **Condensation polymers:** These polymers are formed by the repeated condensation reaction of different bifunctional or trifunctional monomers, with the elimination of small molecules like $H_2O$,HCl, $CH_3OH$.

For example:




| Condensation polymerisation | Addition polymerisation |
|---|---|
| 1. It is formed by the combination of large number of monomers having multifunctional groups to form polymers with loss of small molecules like $H_2O$, $NH_3$, etc. | 1. It is formed by addition reaction of large number of monomers having double bond without any loss of small molecules. |
| 2. It is step growth polymerisation, e.g. Nylon-6,6 | 2. It is chain growth polymerisation, e.g. Polythene. |

***On the basis of the molecular forces the polymers can be classified as:***

Elastomers: These polymers are held together by weak van der Waals forces and have low elasticity.Theweak binding forces permit the polymer to be stretched. For example: Buna-S, buna-N, neoprene.

**Fibres**: These are the polymer held together by strong hydrogen bonds. They have high tensile strength and sharp melting point.They have strong intermolecular forces. For example: Nylon6.6, polyester, silk, wool, orlon, rayon.

**Thermoplastics polymers**: They are the polymers having intermolecular forces of attraction intermediate between elastomers and fibers. They can be made soft and remoulded by heating. For example: Polythene, PVC, polystyrene,

**Thermosetting polymers**: These are the hard, rigid, cross-linked polymers. They cannot be remoulded once set into a desired shape. For example: Melamine, bakelite.

| Thermoplastic polymers | Thermosetting polymers |
|---|---|
| 1. Molecular structure: They are linear polymers with no cross-linkages. | 1. They are cross-linked polymers. |
| 2. Behaviour: They become soft on heating. Example: Polythene. | 2. They do not become soft on heating. For example, Bakelite. |

Q1 Describe the classification of polymers on the basis of structure.

Q2How does homopolymer differ from copolymer?

Q3Differentiate between the following

a)Thermoplastic and thermosetting plastic

b)Addition and condensation polymer

Q4

Is  a homopolymer or a copolymer?

Q5Explain the following terms giving a suitable example for each:

1. Elastomers
2. Fibre

INSTRUCTIONS

STEP1 Revise the first part of surface chemistry

STEPII Prepare the second part of surface chemistry i.e from colloids

STEPIII Complete the work given on second part of surface chemistry

STEPIV Read The first part of the chapter polymers and prepare till classification of polymers and then go through the notes and answer Q1 to 5