POLYMERS

Polymers are very large molecules having high molar mass and are formed by the combination of a large number of simple molecules called monomers. The process of formation of polymers from respective monomers is called polymerisation. The word 'polymer' is derived from two Greek words - poly (means many) and mer (means unit or part). Polymers are also called macromolecules. E.g. polythene, polypropene, polystyrene, polyesters, polyamides, synthetic fibres, synthetic rubbers etc.

Classification of Polymers

The following are some of the common classifications of polymers:

Classification Based on Source: Based on this, polymers are classified into three: 1. Natural polymers: These polymers are found in nature. Examples are proteins, cellulose, starch, natural fibres and natural rubber.

Semi-synthetic polymers: Cellulose derivatives such as cellulose acetate (rayon) and cellulose nitrate are the examples of this category

Synthetic polymers: These are man-made polymers. E.g. plastics like polythene, poly styrene, PVC etc. Synthetic fibres like nylon 6,6 and synthetic rubbers like Buna – S.

Classification Based on Structure of Polymers: Based on this polymers are divided into three:

1. **Linear polymers**: They contain long and straight chains of polymers. E.g. high density polythene, polyvinyl chloride, etc

2. **Branched chain polymers:** These polymers contain linear chains having some branches. E.g. low density polythene.

3. **Cross linked or Network polymers:** These are usually formed from bi-functional and tri-functional monomers and contain strong covalent bonds between various linear polymer chains. E.g. bakelite, melamine, etc.

Classification Based on Mode of Polymerisation: Based on this polymers are classified into two: 1. Addition polymers: These are polymers formed by addition polymerisation reaction. Here the monomer molecules should possess double or triple bonds. Addition polymers are now known as chain growth polymers. E.g. polythene, polypropene, polystyrene, polyvinyl chloride etc.

Condensation polymers: These are polymers formed by condensation polymerisation reaction. In this polymerisation reaction, the elimination of small molecules such as water, alcohol, hydrogen chloride, etc take place. Here the monomers should be bifunctional or polyfunctional. Condensation polymers are now known as step growth polymers.

Classification based on the type of monomers: Based on this, polymers are of two types:

1. Homopolymers: These are polymers containing only one type of monomer unit. E.g.: polythene, polystyrene. polypropene etc.

2. Copolymers: These are polymers containing different types of monomer units. E.g.: Polyesters like glyptal, terylene etc. poly amides like Nylon-6, Nylon-6,6 etc

Classification based on the Molecular Forces: Based on this, polymers are of 4 types:

Elastomers: These are rubber – like solids with elastic properties. In these polymers, the polymer chains are held together by the weakest intermolecular forces (van der Waal's force). So they can be stretched. A few 'cross links' are

formed in between the chains, which help the polymer to regain to its original position after the force is released. E.g. buna-S, buna-N, neoprene, etc.

Fibres: Fibres are the thread forming solids which possess high tensile strength and high modulus. Here the different polymer chains are held together by strong intermolecular forces like hydrogen bonding. So they have close packed structure and are crystalline in nature. E.g. Nylon-6,6, Nylon-6, terylene etc.

Thermoplastic polymers: These are the linear or slightly branched long chain molecules repeatedly softening on heating and hardening on cooling. polymers possess intermolecular forces of attraction in between examples are polythene, polystyrene, polyvinyls, etc.

Condensation Polymerisation or Step Growth polymerization

This type of polymerisation involves a repetitive condensation reaction between two bi-functional monomers. It results in the loss of some simple molecules like water, alcohol etc., and lead to the formation of high molecular mass condensation polymers. In these reactions, the product of each step is again a bi-functional species. Since, each step produces a different functionalised species and is independent of each other; this process is also called as step growth polymerisation. Some examples of condensation polymers are:

Vulcanisation of rubber

To improve the physical properties of natural rubber, it is heated with sulphur and an appropriate additive at a temperature of 373 to 415 K. This process is called vulcanisation. On vulcanisation, sulphur forms cross links between the different poly isoprene units and thus the rubber gets stiffened.

2. Synthetic rubbers: These are either homopolymers of 1, 3 - butadiene derivatives or copolymers of 1, 3 - butadiene or its derivatives with another unsaturated monomer. Some examples are:

Biodegradable Polymers

These are polymers which can be decomposed by micro organisms. They contain functional groups similar to the functional groups present in biopolymers like starch, cellulose etc. Aliphatic polyesters are one of the important classes of biodegradable polymers. Some important examples are: