POLYMER

Polymers are the substances of high molecular mass formed by the combination of simple molecules (monomers).

Polymerisation is the process by which the monomers are converted into polymers.

Types of Polymers

i) Natural Polymers which are found in nature e.g., proteins, polysaccharides, natural rubber etc.

ii) Synthetic polymers are the one which are synthesized e.g., polythene, nylon, terylene, decron, glyptal etc.

Elastomers are the type of polymers in which the polymer chains are held together by weak Van der waal's forces, e.g., vulcanized rubber.

Fibres are the type of polymers in which the intermolecular forces between the chains are hydrogen bonds,e.g., nylon 66.

Thermoplastics are the type of polymers in which the intermolecular forces are intermediate between those of elastomers and fibres, e.g., polystyrene.

HOMOPOLYMERS		
Common name of the homopolymer	**Monomer**	**Uses**
Polyacrylonitrile (PAN)	CH_2=CH – CN Acrylonitrile	In the manufacture of orlon (fiber) and acrilon films.
Teflon(Polytetrafluoro ethene)	CF_2=CF_2 Tetrafluoro ethylene	In the manufacture of insularos, gakets etc.
Buna rubber	CH_2=CH–CH=CH_2 1,3–Butadiene	In the manufacture of tyres, hoses etc.
Polyethylene	CH_2 = CH_2 Ethylene	In the manufacture of pipes, toys, bags, wire insulators, bottles etc.
Polyvinyl Chloride (PVC)	CH_2 = CHCl Vinyl chloride	In the manufacture of sheets, water pipes, hoses, hand bags etc.

Polystyrene	$C_6H_5CH = CH_2$ Styrene	In the manufacture of combs, toys and radio and television cabinets etc.

COPOLYMERS		
Common name of the copolymer	**Monomer**	**Uses**
Bakelite	(i) HCHO Formaldehyde (ii) C_6H_5OH Phenol	In the manufacture of electrical goods, phonograph records, fountain pen etc.
Polyurethane	(i) $HOCH_2 – CH_2OH$ Ethylene glycol, (ii) O=C=N–CH=CH–N=C=O Ethylene di-isocyanate	In the manufacture of fibres, paints and heat insulators.

Dacron or Terylene	(i) $HOCH_2 - CH_2OH$ Ethylene glycol (ii) $H_3COOC(C_6H_4)COOCH_3$	In the manufacture of fabrics and magnetic recording
Nylon–66	(i) $H_2N(CH_2)_6NH_2$ Hexamethylene diamine (ii) $HOC(CH_2)_4COOH$ Adipic acid	In the manufacture of fabrics, tyre cords, ropes, carpets etc.

Classification of Polymers

The polymers may be classified in a number of ways depending upon one criterion or the other as described below:

Classification based upon origin:

On the basis of their origin, polymers may be classified into three groups:

(i) Natural polymers

(ii) Semi-synthetic polymers

(iii) Synthetic polymers

(i) Natural polymers: These are substances of natural origin, i.e., these are found in nature mainly in plants and animals. The well-known natural polymers are proteins (polymers of amino acids), polysaccharides (polymers of monosaccharides) and rubber (polymer of isoperene, i.e., 2–methyl–1,3–butadiene). Silk, wool, starch, cellulose, enzymes, natural rubber, haemoglobin, etc., are the examples of natural polymers.

(ii) Semi–synthetic polymers: These are the substances which are obtained by using natural polymers, i.e., some modification are made in natural polymers by artificial means. Nitrocellulose, cellulose acetate, cellulose xanthate, etc., belong to this class of polymers.

(iii) Synthetic polymers: These are manmade polymers, i.e. polymers synthesized in laboratory.

Classification based upon synthesis: On the basis of mode of synthesis, polymers are classified into two categories.

Addition polymers: These are polymers formed by the addition together of the molecules of the monomer or monomers to form a large molecule without elimination of anything. The process of the formation of addition polymers

is termed addition polymerization. The addition polymers are formed by monomers which are unsaturated compounds, e.g., ethene and derivatives of ethene. An addition polymer has the same empirical formula as the monomer. Ethene, vinyl chloride and vinyl cyanide are some of the compounds which undergo addition polymerization.

Condensation polymers: Condensation polymers are formed by the combination of monomers with the elimination of simple molecules such as water or alcohol. This process of formation of polymers is called condensation polymerization.

Classification based upon molecular forces: The utility of polymers in various fields is due to their mechanical properties like tensile strength, elasticity, toughness, etc. These properties mainly depend upon the intermolecular forces like van der Waals' forces and hydrogen bonding operating in polymer molecules. Polymers have been classified into four types on the basis of the magnitude of intermolecular forces present in them.

Elastomers: These are the polymers having very weak intermolecular forces of attractionbetween the polymer chains. The weak forces permit the polymer to be stretched. Few chemical bonds are introduced between the chains

which act as cross links. These cross–links help the polymer to come to its original position after the force is released. Elastomers thus, possess elastic character. Vulcanised rubber is a very important example of an elastomer.

Fibres: These are the polymers which have bit strong intermolecular forces such as hydrogen bonding. These polymers can be used for making fibre as their molecules arelong and thread like. Nylon–6,6 is an important example of this type.

Thermoplastics: These are polymers in which intermolecular forces of attraction are neither very strong nor very weak and there are no cross–links between the chains. These can be easily moulded by heating, i.e., a thermoplastic polymer is one which softens on heating and becomes hard on cooling. Polyethylene, polystyrene are the examples of thermoplastics.

Thermosetting polymers: These are polymers in which extensive cross links are formed between polymer chains on heating. A thermosetting polymer becomes hard on heating. Such polymers are prepared in two steps. The first step is the formation of long chain molecules which are capable of further reaction with each other. The second step is the

application of heat which causes a reaction to occur between the chains, thus producing a complex cross–linked polymer. Bakelite is an example of thermosetting polymers.