

Unit 1 → Chemistry of Polymers

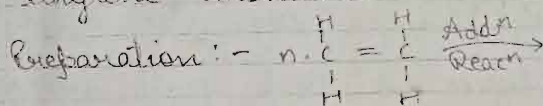
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Polymers

The word polymer implies many parts or many units. A polymer is a compound of high molecular mass formed by combination of large no. of small molecules.

The small molecules which constitute the repeating units in a polymer are called monomer units. The process by which monomers are transformed into polymer is called "polymerisation".

eg - Polyethylene is a polymer obtained by polymerisation of ethylene monomer.



PVC (Poly vinyl chloride)

where n = no. of monomer

units present. Generally, the value of n is in thousands. In other words polymers are single giant molecules due to their large size, they are also called "macromolecules".

HOMO-POLYMER

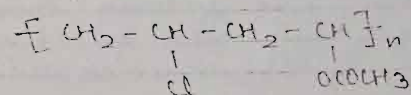
Polymers which are synthesised from only one kind of monomer are called "homopolymer".



CO-POLYMER

Polymers which are prepared from more than one kind of monomer are called "co-polymers" or "mixed polymers".

eg - Vinyon (Vinyl chloride vinyl acetate)

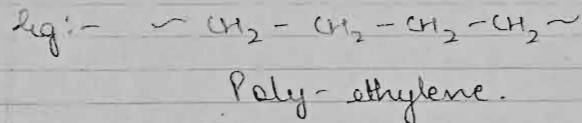


Polymers on the basis of chain structure

The monomeric units may combine with each other into a molecule to form polymers of linear, branched or cross-linked structure.

(i) Linear Polymer

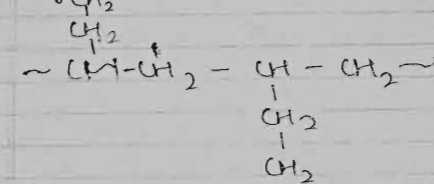
Each monomeric unit is linked to two monomeric units on either side forming a continuous chain



(ii) Branched Polymer

In some cases, some side growth also takes place from the main chain. Most of the units are linked with two other units on either side & some monomeric units may also get linked with third monomeric unit.

eg: CH_2 Branched Polyethylene



(iii) Cross-linked Polymers

During polymerisation, a large no. of branched chain polymer molecules may be formed & on further polymerisation, the side chains from one molecule could possibly link with those from the neighbouring ones.

These polymers in which chains are cross-linked to give a solid with three dimensional network are termed as three dimensional polymers or cross-linked polymers.

eg:- Bakelite

Types

Random

It consists of monomer units which are

$\sim A - A -$

Alternating

In this, the units are arranged in an alternating sequence

eg:- Polystyrene

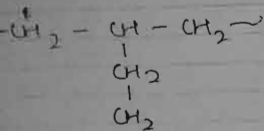
$\sim A - B -$

Block

Linear units are arranged in a fairly regular sequence

$\sim A - B -$

Branched Polyethylene



cross-linked Polymers

During polymerisation, a large branched chain polymer may be formed & on further polymerisation, the side chains from one molecule could link up with those from the neighbouring ones.

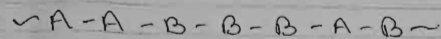
Polymers in which chains are cross-linked to give a solid three dimensional network, are known as cross-linked polymers.

kelite

Types of Co-Polymer.

① Random Co-Polymer

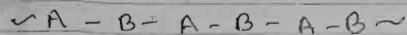
It consists of two or more monomer units in the chain which can be randomly arranged.



② Alternate Co-Polymer

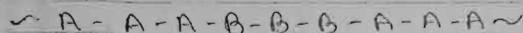
In this type, the monomer units are arranged in a regular alternating fashion.

eg:- Polyesters, Polyamides



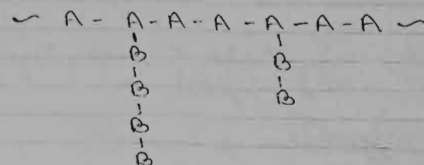
Block Co-Polymers

Linear polymers in which the units of each type are formed in fairly long chain in continuous sequence i.e., blocks, are known as Block Co-Polymer.



④ Graft Co-Polymer.

Branched Co-Polymerⁱⁿ which one kind of monomer is in the main chain & other kind of monomer in side chain are called Graft Co-Polymer.



Polymer on the basis of synthesis

These are of 3 main types:-

① Addition/Chain growth Polymerisation

In this type of polymerisation, the polymer is formed from the monomer without the loss of any material and the product is an exact multiple of original monomeric molecule.

The molecular mass of addition polymer is integral multiple of that monomeric unit.

The monomeric units are unsaturated compounds usually alkenes or derivatives of alkenes.

eg:- Polyethylene, Polystyrene, PVC, etc.

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② Condensation Polymers / Step Growth Polymers.

In this type of polymer, the monomers react together and the elimination of smaller molecules like H_2O , ROH , HCl , etc. takes place.

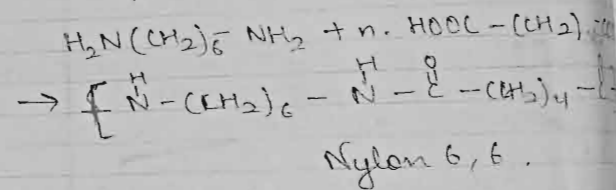
The reaction is called condensation and the product form is called condensation polymer.

As this process involves the elimination of by-product

molecules, the molecular mass of the polymer is not the integral multiple of monomeric units.

eg:- Nylon 6,6 is a condensation polymer of hexamethylene di-amine.

Preparation of Nylon 6,6:-



Co-Polymerisation

In this, two or more monomers are jointly polymerised to form a polymer, high molecular weight compounds formed by co-polymerisation are known as co-polymer.

Polymers and Applications

Polymers have been divided into 4 categories of magnitude of forces or are elastomers.

Elastomers

These are polymers which the chains are held up by attractive forces between the chains. They can be stretched. A few cross-links are introduced which help them to return to their original shape after the force is removed. These are known as elastomers having high elasticity.

eg:- Rubber, etc.