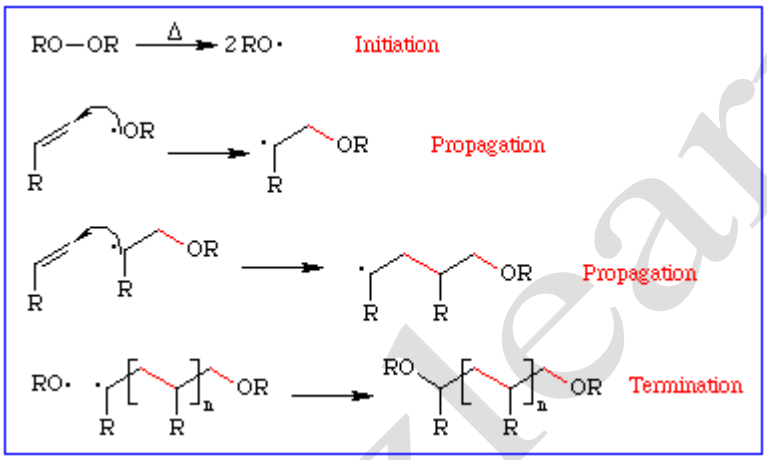
Polymers

A synthetic fiber is also a chain of small units joined together. Each small unit is actually a chemical substance. Many such small units combine to form a large single unit called a polymer. Example: Nylon, polythene, Teflon etc.

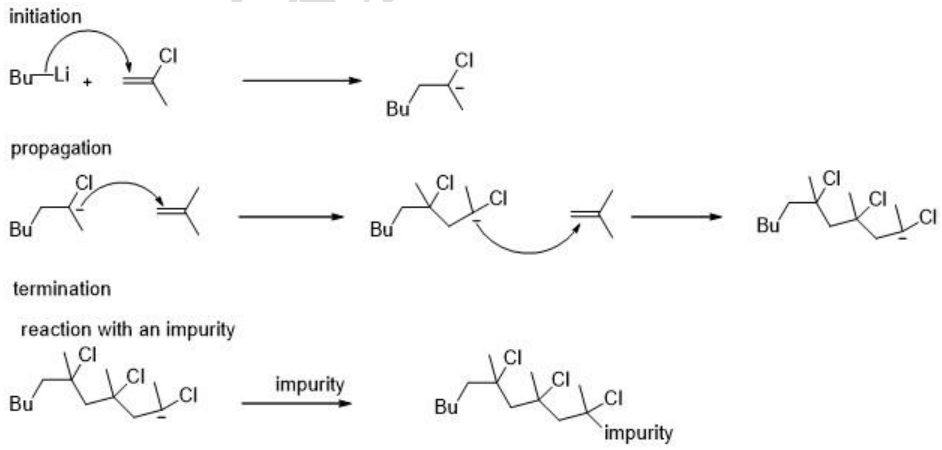
Types of polymerization

There are following type of polymerization is present :
1. Step-growth polymerization.
2. Chain-growth polymerization.

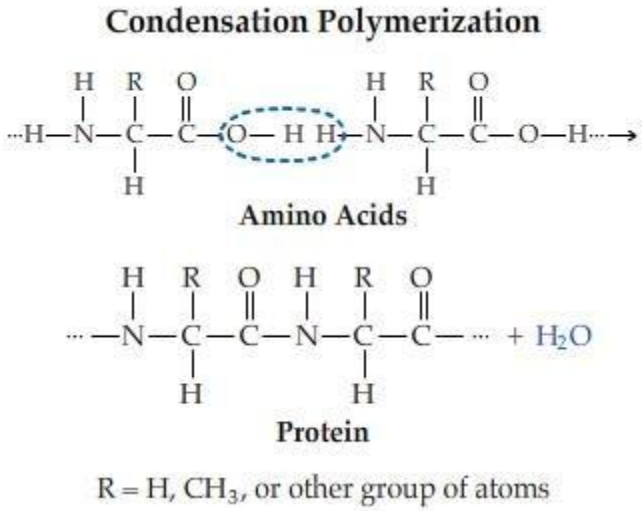
Free radical addition polymerization



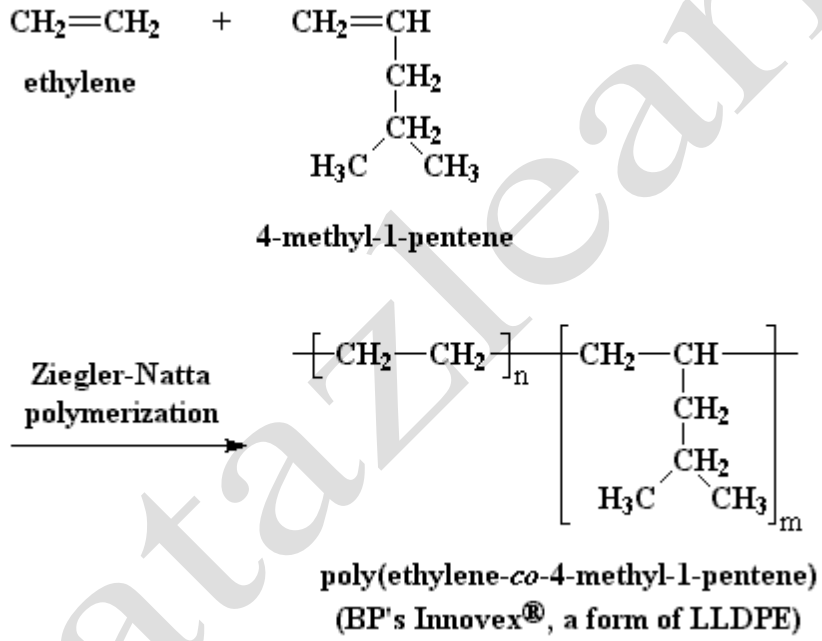
Cationic addition polymerization



Condensation polymerization



Preparation of Low density polymer



Use of High density polymer

1. High-density polythene is a high melting polymer having high density.
2. It is translucent polymer.
3. It is chemically inert but has greater toughness, hardness and tensile strength than low-density polythene.
4. Uses : It is used in the manufacture of containers , housewares, pipes , toys , etc.

Uses of orlon

1) This fibre is of moderate strength.
2) Like the other Acrylics, Orlon has little stretch.
3) It has very good resilience and therefore will not wrinkle easily,
4) It has resistance to light.

Polyamides

Polyamides are polymers where the repeating units are held together by amide links. An amide group has the formula - $CONH_2$.

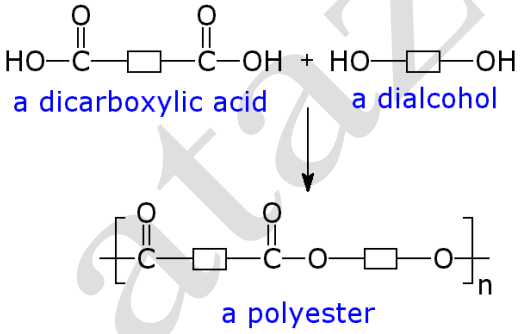
Properties of nylon 6,10

1) Lower moisture absorption.
2) retains its room temperature toughness at low temperatures.
3) resists the environmental stress cracking action of salts such as zinc chloride.

Properties of nylon 6

1) Tough, possesses high tensile strength.
2) elastic and lustre.
3) wrinkle-proof and highly resistant to abrasion.

Preparation of Polyesters



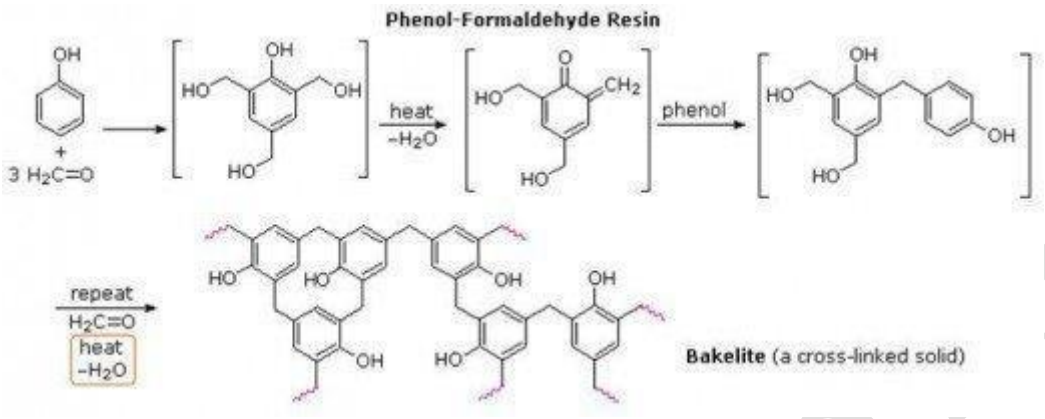
Preparation of Polyesters

Properties of polyesters:
1. These types of polymers have esters linkage.
2. They are resistant to heat, crease , chemicals, light , moths, bacteria.

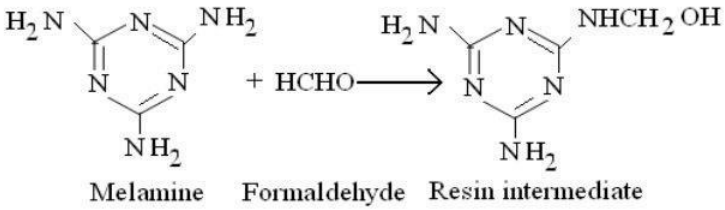
Uses:

1. It is used in preparation of fishing nets, ropes , trousers, magnetic tape recorders, treys etc.

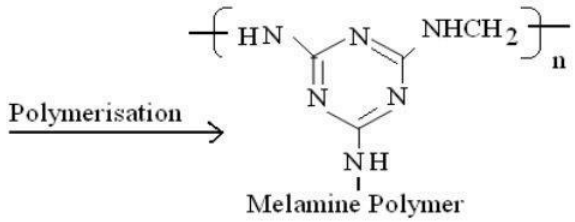
Preparation of Bakelite



Preparation of Melamine-formaldehyde polymers



(2, 4, 6 triamino - 1, 3, 5- triazine)



It is used in the manufacture of unbreakable crockery

Properties of Melamine-formaldehyde polymers

1) it decomposes and releases a significant amount of inert, non toxic gas.

2) flame retardant in polyurethane foams is extremely simple.

3) Melamine resins with strong thermosetting attributes are molded into a variety of translucent, heat-resistant products.

Copolymerization

When two different types of monomers are joined in the same polymer chain, the polymer is called a copolymer.

Properties of copolymers

Properties of polyesters:
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2. They are resistant to heat, crease , chemicals, light , moths, bacteria.
Uses:
1. It is used in preparation of fishing nets, ropes , trousers, magnetic tape recorders, treys etc.

Structure of vulcanized rubber

1. Co polymers are the hetero polymers containing multiple units of each monomer in a chain.
2. The co polymer can be made not only by chain growth polymerization but also by step growth polymerization.
3. The polymers of required and desired properties can be obtained by the combination of three or more monomers.
4. Co polymers are used as a film for wrapping food.

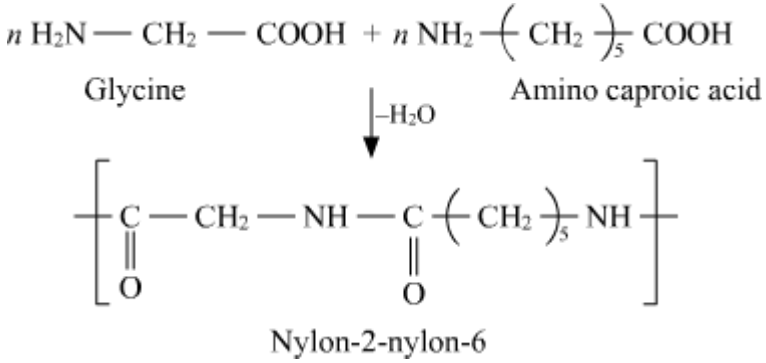
Biodegradble polymers

1. The polymers which are degraded by micro - organism within a suitable period so that the polymers and their degraded products do not cause any serious effects on the environment are called biodegradable polymers.
2. Example : Dextron, Nylon-2-nylon-6 etc.

Properties of PHBV

1. biodegrable, nontoxic, biocompatible plastic.
2. It is thermoplastic linear aliphatic polyester.
3. It is brittle, has low elongation at break and low impact resistance.

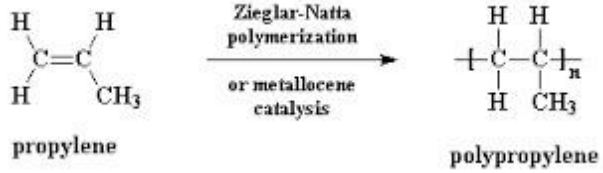
Formation of nylon-2 nylon-6



Properties of nylon-2 nylon-6

- Functional group is amide
- Light in weight
- Incredible tensile strength
- Durability
- Resistance to damage
- Takes dye easily
- Absorbs most water
- Greater stretchability
- Dries slower
- smoother and softer fabric than polyester
- Somewhat UV resistant

Polypropene

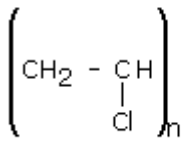


Polystyrene

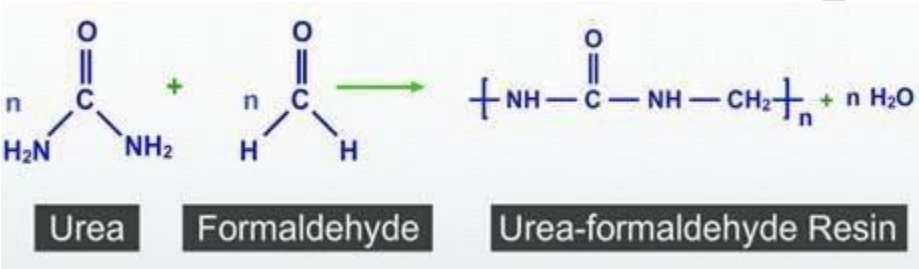
1. Polystyrene is polymers which is prepared by monomer steryne.
2. It is an aromatic polymer.
3. Polystyrene molecule contain long chain carbon and hydrogen bonds which is attached to phenolic ring.

4. It is used to prepare many different types of containers, shaving razors , packaging materials etc.

PVC

Poly Vinylchloride PVC - 	Vinylchloride $CH_2=CH-Cl$	Pliable i.e., easily moulded polymer	For making rain coats, hand bags, plastic dolls, curtain cloth, vinyl flooring, insulating material in wires and other electric goods

Urea formaldehyde



polymer and macromolecule

Polymers are huge molecules containing identical building blocks. Each polymer has a repeating unit, it is called the monomer. The word polymer means many parts (poly = many and mer = parts); the term is derived from two Greek words polus (= many) and meros (= parts). There are naturally occurring polymers as well as artificially synthesized polymers; shellac , wool, silk, natural rubber and amber are some example. A macromolecule is a giant molecule that consists of thousands of atoms.They have a molecular weight ranging from several thousands to several millions and the size from several tens of nanometers (nm) to few centimeters (cm). Carbohydrates, proteins, lipids, and nucleic acids are some examples for macromolecules.

Homopolymers

When a single monomer is polymerized into a macromolecule, the product is called a homopolymer. e.g PVC

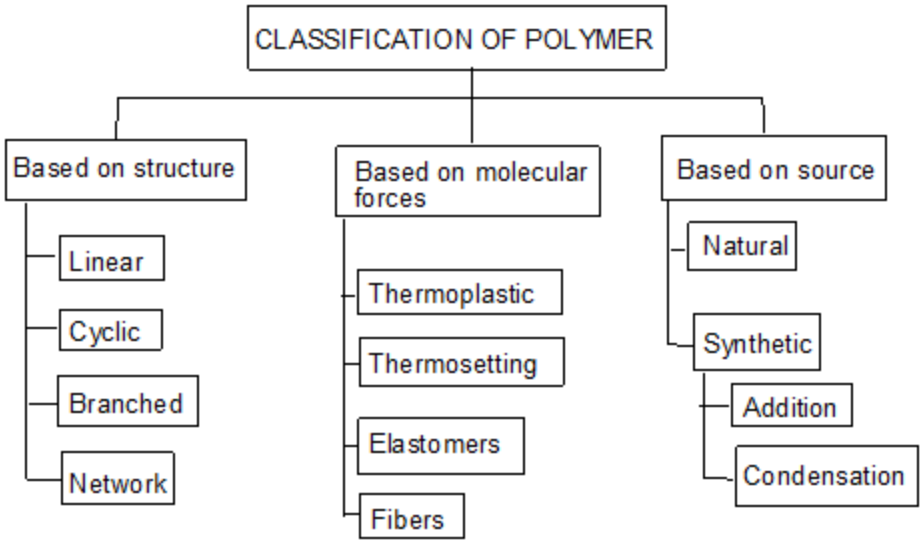
Homopolymers

1. Homo polymer is a product of many monomers which undergoes in polymerization.
2. Homo polymers are prepared by same monomeric units.

Characterstics of copolymers

1. When two different monomeric unit joined together to form long chain plymers by polymerization process, it is called as copolymers.

Ways of polymer's classification



Natural , semi-synthetic and synthetic polymer

1. Natural polymers : The polymers obtained from nature (plants and animals) are called as natural polymers.
eg. Natural rubber, wool, silk, starch, jute etc.
2. Semi-synthetic polymers : The polymers in which properties of natural polymers such as appearance, tensile strength, luster, etc are modified by some chemical treatments are called as semi-synthetic polymers.
eg. Acetate rayon, viscose rayon etc.
3. Synthetic polymers: The polymers which are synthesized in the labs or in industries are called as synthetic polymers.
eg. Plastics, synthetic fibers etc.

Polymer classification on the basis of their structure

On the basis of structure , polymers are divided into three types.
1. Linear ploymers
2. Branched polymers
3. Network or cross linked polymers.

Linear polymers

1. Linear polymers : They are made up of long continuous chains without any excess attachments.The repeating units are joined together to form a long chain.
2. These are well packed and therefor , have high densities, high tensile strength and high melting points.
3. Eg. Polythene ,PVC.

Linear polymers – characteristics

1. They are made up of long continuous chains without any excess attachments.The repeating units are joined together to form a long chain.
2. These are well packed and therefor , have high densities, high tensile strength and high melting points.

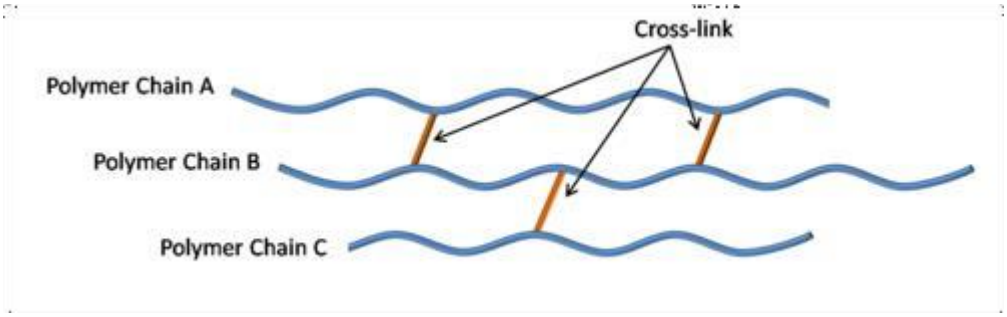
Branch chain

1. These polymers consists of chain structure having one main chain of molecules with smaller chains as branches of main chain.
2. Example : Polypropylene.

Characteristics of branch chain polymers

1) It will not flow easily when heated.
2) They will have a higher melting point than linear chains.
3) Typically have the properties of a slightly less ductile material (stronger and stiffer).

Cross-linked polymers



Characteristics of Cross-linked polymers

1. The Cross linked bonding retains its shape when heated.
2. These also have a higher melting point than linear and branched bonds
3. The two main types of polymers are thermo sets and thermo plastics.

Cassify polymers on the basis of mode of polymerization

On the basis of mode of polymerization, polymers are classified into the following groups:
1. Addition polymers.
2. Condensation polymers.

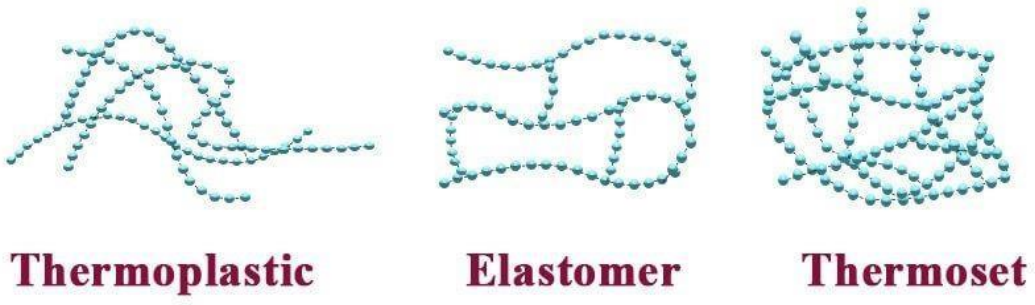
Additional polymerization

1. The polymers which are formed by addition polymerization process in which alkene polymers are used are called as addition polymers.
2. Example : Orlon, Teflon, PVC, Polythene, etc.

Condensation polymerization

1. Condensation polymers are formed by combination of two monomers by elimination of small molecule like water or methyl alcohol.
2.The process of formation of condensation polymers is called as condensation polymerization.
3. Example : Poly amides, Polyesters, etc.

Classify polymers on the basis of molecular forces



Elastomers

1. The polymers that have elastic character like rubber are called as elastomers.
2. Example : Neoprene , Vulcanized rubber, etc.

Characteristics of elastomer

1. When small amount of stress is applied the polymers chains get easily stretched.
2. When the stress is removed, the polymer chains regain the original shape.
3. This property is known as elasticity.
4. Elastomers are soft and stretchy.
5. They are used for making rubber bands.

Plasticizers

1. Synthetic resin reacted with chemical substance to make it plastic like.
2. That chemical substance is called as plasticizers.
3. Example : Phthalate esters.

Thermosetting polymers

1. Thermosetting polymers are cross linked or heavily branched molecules, which on heating undergo extensive cross linking in moulds and again become in-fusible.
2. Example : Bakelite, Resins , etc.

Effect of structure on the properties of a polymer

1. Structure effect the properties of a polymer :
2. For Example : In case of natural rubber there is C=C double bonds present in cis configuration, because of these configuration it is not possible for the chains to come closer.Hence the inter molecular attractive forces are weak.Hence natural rubber is non=crystalline with long flexible chains and shows elastic properties.