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Polymers

Polymers are high molecular weight compounds formed by the repetitive bonding of small molecules known as monomers. The chemical process through which monomers convert to polymers is termed **polymerization**.

Categories of Polymers

1. **Natural Polymers:** Occur naturally, e.g., proteins, cellulose, rubber.
2. **Synthetic Polymers:** Man-made, e.g., polyethene, nylon, terylene, glyptal.

Based on Intermolecular Forces:

- **Elastomers:** Soft and stretchable due to weak van der Waals forces, e.g., vulcanized rubber.
- **Fibres:** Possess strong hydrogen bonding; thread-like, e.g., Nylon-6,6.
- **Thermoplastics:** Soften on heating, harden on cooling; no cross-linking, e.g., polystyrene, polyethene.
- **Thermosetting Polymers:** Undergo permanent hardening upon heating due to cross-linking, e.g., Bakelite.

Homopolymers

Polymer Name	Monomer	Applications
Polyacrylonitrile (PAN)	Acrylonitrile ($CH_2 = CH - CN$)	Used for making orlon fibre and films.
Teflon	Tetrafluoroethylene ($CF_2 = CF_2$)	Used in electrical insulation and cookware coatings.
PVC	Vinyl chloride ($CH_2 = CHCl$)	Pipes, rainwear, handbags.
Polyethene	Ethene ($CH_2 = CH_2$)	Packaging, toys, containers.
Polypropylene	Propene ($CH_2 = CH(CH_3)$)	Ropes, mats, plastic furniture.
Polystyrene	Styrene ($C_6H_5CH = CH_2$)	Packing materials, electronic housings.
Polyvinyl acetate	Vinyl acetate ($CH_2 = CH(OCOCH_3)$)	Adhesives, paints.
Orlon	Acrylonitrile ($CH_2 = CH(CN)$)	Blankets, sweaters, upholstery.

Copolymers

Polymer Name	Monomers	Applications
Buna-S	Buta-1,3-diene + Styrene	Tyres, footwear.
Buna-N	Buta-1,3-diene + Acrylonitrile	Oil-resistant parts, hoses.
Nylon-6,6	Hexamethylenediamine + Adipic acid	Brushes, fibres, engineering plastics.
Nylon-6	Caprolactam	Ropes, fishing nets, textiles.
Terylene (Dacron)	Ethylene glycol + Terephthalic acid	Textiles, seat belts.
Glyptal	Ethylene glycol + Phthalic acid	Paints, coatings.
Bakelite	Phenol + Formaldehyde	Electric switches, utensil handles.
Melamine-formaldehyde	Melamine + Formaldehyde	Crockery, kitchenware.

Polymer Molecular Mass

Polymers are large molecules, and their physical behavior depends on their molecular mass. Techniques for determining molecular mass include osmometry, viscometry, and light scattering.

Biodegradable Polymers

Environmentally friendly polymers that degrade by microbial action. Notable examples:

- PHBV (Poly- β -hydroxybutyrate-co- β -hydroxyvalerate)
- Nylon-2-Nylon-6