

## Biodegradable Polymers

Non-resistant to environmental degradation and have functional group similar to functional group of Biopolymers.

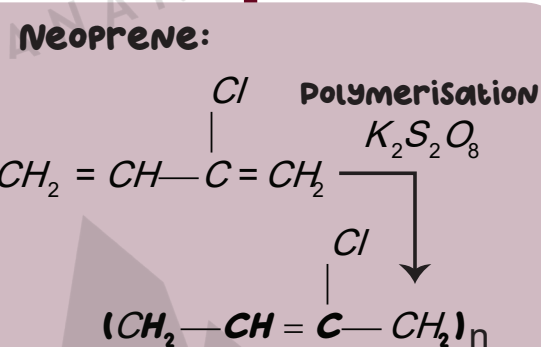
EXAMPLES: Poly- $\beta$ -hydroxy butyrate-co- $\beta$ -hydroxy valerate (PHBV), NYLON-2-NYLON-6.

## Types of Rubber

(i) Natural Rubber: Linear polymer of Isoprene (2-methyl-1, 3-butadiene)

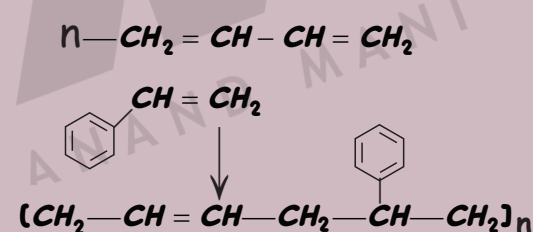
VULCANISATION OF RUBBER:  
RAW RUBBER + SULPHUR  
 $\xrightarrow[373-475\text{ K}]{\Delta}$   
Stiffened rubber

SYNTHETIC RUBBER: Homopolymer of 1, 3-butadiene Derivative. Example: BUNA-S, BUNA-N Neoprene

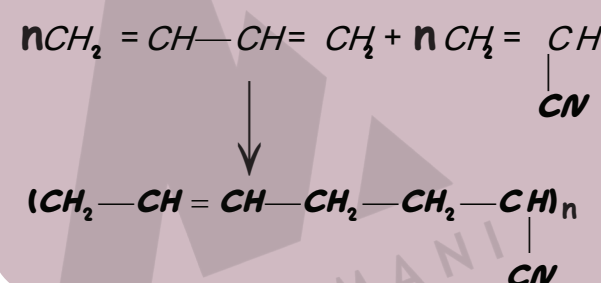


**Copolymerization:** A mixture of more than one polymeric species undergoing polymerization.

EXAMPLE:



BUNA-N:



## Polymers of Commercial Importance

(1) POLYPROPENE USED FOR MANUFACTURING OF ROPES AND TOYS.  
(2) Bakelite is USE FOR MAKING ELECTRICAL SWITCHES

Very large molecules having high molecular mass. ( $10^3 - 10^6$ )

# POLYMERS

## Classification

### Based on Source

**Natural Polymers:** Found in plants and animals. Examples: Proteins, Cellulose.

**Semi-Synthetic Polymers:** These are Cellulose Derivative. Examples: Cellulose Nitrate.

**Synthetic Polymer:** Man-made polymer. Examples: Polythene, BUNA-S, NYLON-6,6.

### Based on Structure

**Linear:** Long and straight chains. Examples: Fibres and Plastics.

**Branched:** Linear chains with branches. Examples: Amylopectin, glycogen.

**Cross linked or Network Polymer:** Strong covalent bonds between various linear polymer chains. Examples: Bakelite, Melamine.

### Based on Polymerization

**Addition Polymer:** Repeated Addition of Monomers containing Double or Triple bond.

**Homopolymer:** Formed by polymerisation of single monomeric species E.g. Polythene

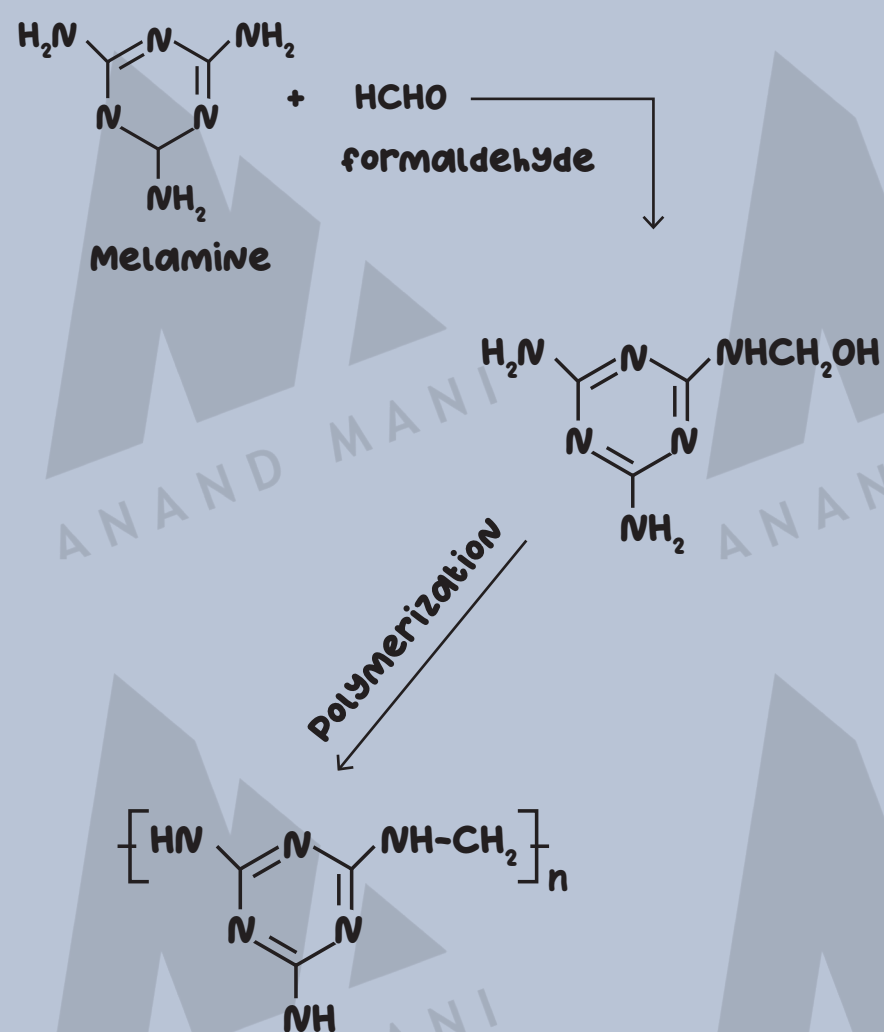
**Copolymer:** If two different monomers are used, then it is known as copolymers.

**Condensation Polymer:** Repeated Condensation between two different bi-functional or tri-functional monomers forms condensation polymer. Examples: Terylene, Nylon 6

## Molecular mass of Polymers

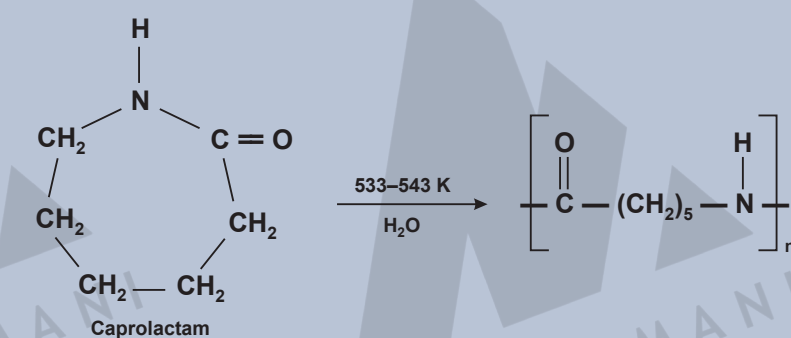
- Expressed as an average
- Determined By Physical and chemical method.

## Melamine - Formaldehyde Polymer



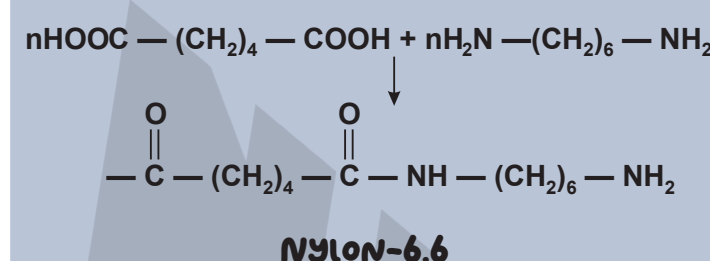
## Preparation

### NYLON-6: Homopolymer of Caprolactam



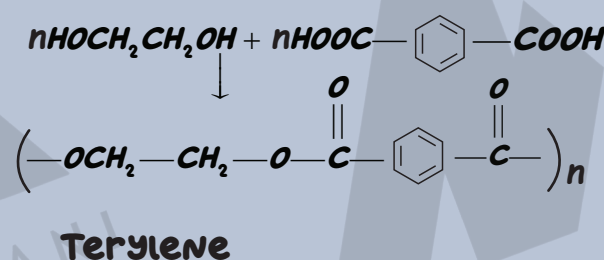
### Polyamides

NYLON-6,6: Copolymer of Adipic Acid and Hexamethylene Diamine.



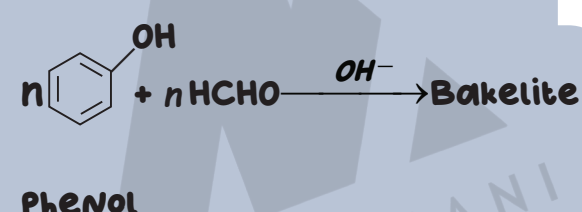
### Polyesters

Terylene (Dacron)



### Thermosetting Resin

Bakelite: Phenol formaldehyde resin.

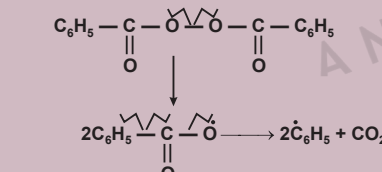


## Types of Polymerization Reaction

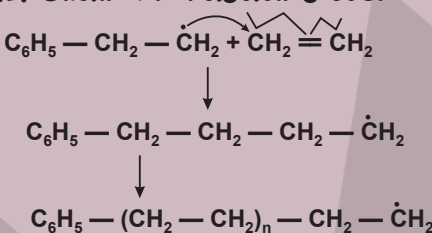
Addition/Chain Growth: Governed by free radical mechanism.

Steps Involved:

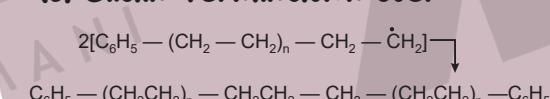
(a) Chain Initiation:



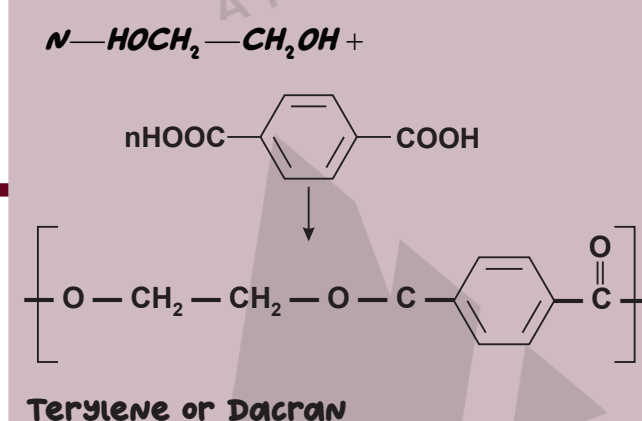
(b) Chain Propagating Step:



(c) Chain Termination Step:



Condensation Step Growth: Involves stepwise intermolecular condensation:



**Fibers:**

Thread forming solids. Examples: Nylon 6,6, Terylene.

**Elastomer:**

Rubber like solids with elastic properties. Examples: BUNA-S, BUNA-N

**Thermoplastic Polymer:**

Linear or slightly branched chain capable of repeated softening on heating. Examples: Polythene, Polystyrene.

**Thermosetting Polymer:**

Cross linked or heavily branched molecules which on excessive heating cross link in mould and become infusible. Examples: Bakelite