• Points to remember in Polymers

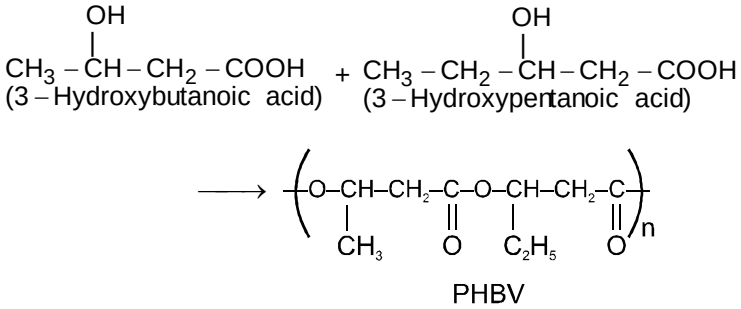
Biodegradable Polymers :

A large number of polymers are quite resistant to the environmental degradation processes and are thus responsible for the accumulation of polymeric soild waste materials. These soild wastes cause acute environmental problems and remain undegraded for quite a long time. In view of the general awareness and concern for the problems created by the polymeric soild wastes, certain new biodegradable synthetic polymers have been designed and developed. These polymers contain functional groups similar to the functional groups present in biopolymers.

Aliphatic polyesters are one of the important classes of biodegradable poylmers. Some examples are given below :

(a) Poly β-hydroxybutyrate – co–β-hydroxy valerate (PHBV) :

It is obtained by the copolymerisation of 3-hydroxybutanoic acid and 3-hydroxypentanoic acid.

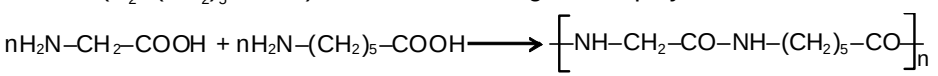


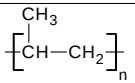
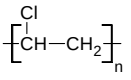
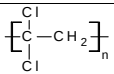
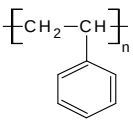
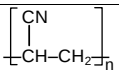
PHBV

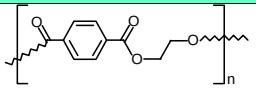
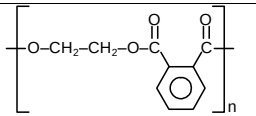
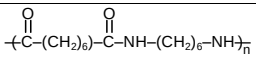
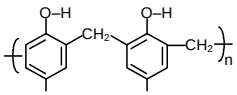
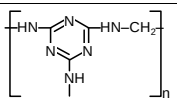
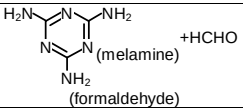
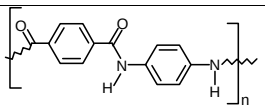
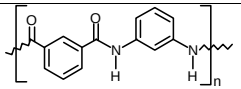
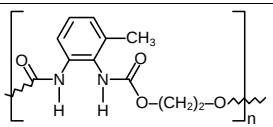
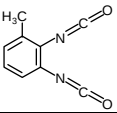
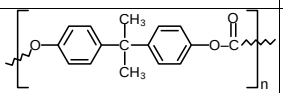
PHBV is used in speciality packaging, orthopaedic devices and in controlled release of drugs. PHBV undergoes bacterial degradation in the environment.

(b) Nylon–2–nylon–6 :

It is an alternating polyamide copolymer of glycine ($H_2N–CH_2–COOH$) and amino caproic acid ($H_2N(CH_2)_5COOH$) and it is also biodegradable polymer.



Some common addition polymers/chain growth polymer				
S. No.	**Name(s)**	**Formula**	**Monomer**	**Uses**
1.	Polyethylene (low density (LDPE))	$-(CH_2\text{-}CH_2)_n-$	$CH_2=CH_2$ (ethylene)	Film wrap, Plastic Bags
2.	Polyethylene (high density (HDPE))	$-(CH_2\text{-}CH_2)_n-$	$CH_2=CH_2$ (ethylene)	Electrical insulation bottles, toys
3.	Polypropylene (PP) different grades		$CH_2=CHCH_3$ (propylene)	Manufacture of ropes, toys, pipes, fibres etc.
4.	Poly vinyl chloride (PVC)		$CH_2=CHCl$ (vinyl chloride)	Manufacture of rain coats, hand bags, vinyl flooring, water Pipes etc.
5.	Poly vinylidene chloride (Saran A)		$CH_2=CCl_2$ (vinylidene chloride)	Seat covers, films & fibers
6.	Polystyrene (Styron)		$CH_2=CHC_6H_5$ (styrene)	As insulator, wrapping material, manufactures of toys, radio and Television cabinets
7.	Polyacrylonitrile (PAN, Orlon, Acrilan)		$CH_2=CHCN$ (acrylonitrile)	Rugs, Blankets clothing
8.	Polytetrafluoroethylene (PTFE, Teflon)	$-(CF_2\text{-}CF_2)_n-$	$CF_2=CF_2$ (tetrafluoroethylene)	Non-stick surfaces electrical insulation
9.	Poly methyl methacrylate (PMMA, Lucite, Plexiglas, perspex)	$-[CH_2C(CH_3)CO_2CH_3]_n-$	$CH_2=C(CH_3)CO_2CH_3$ (methylmethacrylate)	Lighting covers, signs skylights
10.	Poly vinyl acetate (PVAc)	$-(CH_2\text{-}CHOCOCH_3)_n-$	$CH_2=CHOCOCH_3$ (vinyl acetate)	Latex paints, Adhesives
11.	Natural Rubber	$-[CH_2\text{-}CH=C(CH_3)\text{-}CH_2]_n-$ (cis)	$CH_2=CH-C(CH_3)=CH_2$ (isoprene)	Requires vulcanization for practical use
12.	Neoprene	$-[CH_2\text{-}CH=CCl\text{-}CH_2]_n-$	$CH_2=CH\text{-}CCl=CH_2$ (chloroprene)	Synthetic rubber, oil resistant seal, gaskets, hoses & conveyor belts
13.	SBR styrene butadiene rubber (Buna-S)	$-[CH_2\text{-}\underset{\displaystyle Ph}{\underset{\vert}{CH}}\text{-}CH_2\text{-}CH=CH\text{-}CH_2]-$	$H_2C=CHC_6H_5$ and $H_2C=CH\text{-}CH=CH_2$	Tyres, floortiles, foot wear & cable insulation
14.	Nitrile Rubber (Buna-N)	$-[CH_2\text{-}\underset{\displaystyle CN}{\underset{\vert}{CH}}\text{-}CH_2\text{-}CH=CH\text{-}CH_2]-$	$H_2C=CHCN$ and $H_2C=CH\text{-}CH=CH_2$	Making oil seals, tank lining and hoses

Some condensation polymers/step growth polymers				
S.	**Name(s)**	**Formula**	**Monomer**	**Uses**
1.	Polyester/Dacron/ Terylene/Mylar		$HO_2C\ C_6H_4\ CO_2H$ (Terephthalic acid) $HO–CH_2CH_2–OH$ Ethylene glycol	Fabric, Tyrecord
2.	Glyptal or Alkyds resin		$HO_2C–C_6H_4–CO_2H$ (Phthalic acid) $HO–CH_2CH_2–OH$	Paints and Lacquers
3.	Polyamide (Nylon 6,6)	$\sim[CO(CH_2)_4CO–NH(CH_2)_6NH]_n\sim$	$HO_2C–(CH_2)_4–CO_2H$ $H_2N–(CH_2)_6–NH_2$	Parachutes & Clothing
4.	Nylon 6,10		$HOOC–(CH_2)_8–COOH$ $H_2N–(CH_2)_6–NH_2$	
5.	Polyamide Nylon 6, Perlon-L	$\sim[CO(CH_2)_5NH]_n\sim$		Rope & Tyrecord
6.	Bakelite		PhOH + HCHO in (excess)	Electrical Switch, combs, Handle of Utensils, computer discs and Bowling Balls
7.	Urea-formaldehyle resin	$(–NH–CO–NH–CH_2–)_n$	$H_2N–CO–NH_2$ (Urea) HCHO (Formaldehyde)	Making unbreakable cups and laminated sheets.
8.	Melamine formaldehyde resin			Unbreakable crockery
9.	Polyamide Kevlar		Para $HO_2C–C_6H_4–CO_2H$	Tyre
10.	Polyamide Nomex		Meta $HO_2C–C_6H_4–CO_2H$ Meta $H_2N–C_6H_4–NH_2$	
11.	Polyurethane Spandex		$HOCH_2CH_2OH$ 	Foams, Shoes, Automobile seats and components
12.	Polycarbonate Lexan		$(HO–C_6H_4–)_2C(CH_3)_2$ (Bisphenol A) $X_2C=O$ (X = OCH_3 or Cl)	Bike helmet, goggles, bullet proof glass