



19CH201 ENGINEERING CHEMISTRY

UNIT-4 HIGH POLYMERS

BIODEGRADABLE AND NON BIODEGRADABLE POLYMERS

Most of us might have observed that whenever we dump household solid wastes at dumpsites, a part of them disappears after few days (biodegradable wastes) but some of them start accumulating at that place (non-biodegradable wastes). The solid substances which go after few days contain some polymers which are decomposed by the action of microorganisms and are known as Biodegradable Polymer. Whereas the accumulated solid wastes also include some polymers which are not decomposed by the action of microorganisms and are referred to as the non-biodegradable polymers, and accumulation of these wastes cause pollution and severe diseases.

To control these diseases and infections, we have started using eco-friendly synthetic polymers. This kind of polymers consists of similar functional groups as that of the biopolymers. They can be synthetically made by adding molecules of ester, anhydride, and amide. These molecules form a linkage between other molecules.

What are Biodegradable Polymer?

These are those polymers which get decomposed under aerobic or anaerobic conditions, as a result of the action of microorganism/enzymes. The materials develop it like starch, cellulose, and polyesters. Aliphatic polyesters are the most commonly used polymers of this type.

Examples Of Biodegradable Polymers

Some examples are given as follows:-

Poly β -hydroxybutyrate – co- β -hydroxyvalerate (PHBV): It is derived by combining 3-hydroxy butanoic acid and 3-hydroxy pentanoic acid, in which monomers are cross-linked by an



ester linkage. It decomposes to form carbon dioxide and water. It is brittle in nature, and it can be used in the production of drugs and the manufacturing of bottles.

Nylon 2-nylon 6: It is a polyamide copolymerization of glycine ($\text{H}_2\text{N}-\text{CH}_2-\text{COOH}$) and aminocaproic acid ($\text{H}_2\text{N}-(\text{CH}_2)_5-\text{COOH}$).

Polyhydroxybutyrate (PHB): It is formed by the condensation of hydroxybutyric acid (3-hydroxy butanoic acid) molecules.

What is Non-Biodegradable Polymer?

They consist of long chains of carbon and hydrogen atoms. These molecules form an interatomic type of bonding and is adamant meaning it is tough for microbes to break the bonds and digest them. Thus a long period is required to decompose them.

Examples Of Non-Biodegradable Polymer

Some of the examples are:

Polyethylene: They are of three types:

- Linear high-density polyethylene (HDPE)
- Branched low-density polyethylene (LDPE)
- Ultra-high molecular weight polyethylene(UHMWPE)

These have high strength and lubricity and are also used in orthopaedic implants and catheters.

Poly (tetrafluoroethylene) (PTFE) (Teflon): They are chemically and biologically inert and have high lubricity. They are used in hollow fibres for enzyme immobilization, wiring in aerospace, etc.