Degradable Plastics

Degradable plastics as those which undergo a significant change in chemical structure under specific environmental conditions. These changes result in a loss of physical and mechanical properties, as measured by standard methods Biodegradable plastics undergo degradation from the action of naturally occurring microorganisms such as bacteria, fungi and algae.

Biodegradable plastics – plastics that will fully decompose to carbon dioxide, methane, water, biomass and inorganic compounds under aerobic or anaerobic conditions and the action of living organisms.

Aerobic decomposition – biological decomposition in the presence of oxygen or air, where carbon is converted to carbon dioxide and biomass.

Anaerobic decomposition – biological decomposition in the absence of oxygen or air, where carbon is converted to methane and biomass.

Biological decomposition (= biodegradation) – decomposition under the influence of biological systems.

Biomass (= renewable resource) – substance of biological origin, with the exception of geological formations and fossilized biological matter.

Categories of Biodegradable Polymers

Raw materials origin and the process used in their manufacture, categorized BD into three types which are as follows

1.Natural Biodegradable Polymers

The natural BD polymers are obtained from natural resources like (starch, cellulose, lignin, chitin, and chitosan); proteins (wool, silk, collagen, and gelatin.

2. Synthetic Biodegradable Polymer

Polymers derived from petrochemical or biological resources include; polyesters, polyamides, polyurethanes, polyureas, poly (vinyl alcohol), poly (vinyl acetates) (PVA)

3. Biodegradable Polymer Blends

The blending of biodegradable polymers from renewable and non-renewable resources is a way of dropping the overall cost of the material and offers a method of modifying both properties and degradation rates

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Characteristics of an Ideal BD Polymer

- It should be flexible and possess a wide range of properties
- It should be non-toxic, and possess good mechanical strength
- It should be inexpensive
- It should be easy to engineer
- It should be inert to host tissue and compatible with the environment.

Non-Biodegradable Polymers

The polymers which cannot be decomposed by the action of enzymes or chemicals associated with living organisms and their secretion products are called as NBD polymers. For instance of NBD polymers include; polyethylene poly (methyl methacrylate) polyester, polycarbonate, polyamide (nylon) polyurethan.

Table 1: Difference between NBD and BD

Non-biodegradable Polymers	Biodegradable Polymers
Degradation process is very slow	Degradation process is slow
Rate of biodegradation is very low	Rate of biodegradation is very high
Cannot be decomposed by the living organisms	Can be decomposed by the living organisms
Costly chemicals used for decomposition	Cost free decomposition
Cannot be recycled naturally	Can be recycled naturally
Cannot be broken down into harmless substance(s) by any biological processes	Can be broken down into harmless substance(s) by the action of microorganisms like bacteria
Can pollute the environment	Cannot pollute the environment
Remain unchanged over a long period of time	Change their form and structure over time

Factors Affecting Biodegradation

The various factors affecting the biodegradability of polymers are given below:

1)Chemical Structure

The biodegradability of polymers is ultimately controlled by the chemical structures which directly affects on ability of degradation like functional groups.

2)Degree and Type of Branching

Branching of the molecular chain inhibits the biodegradation. Polymers with flexible chains are easily biodegradable. Linear polymers are more easily biodegradable than branched and cross-linked polymers

3)Molecular Size

The high molecular weight of the polymer is more resistant to biodegradation due to the presence of less concentration of end

group in the form of unsaturation, hydroperoxide in the polymer structure.

4)Degree of Hydrophilicity

Polymers containing hydrophilic segments are more biodegradable than hydrophobic polymers of comparable molecular weight.

5)Crystallinity

Crystalline regions of a polymer are difficult to penetrate and thus affect the rate of degradation. Amorphous areas in the polymers are easier to degrade than crystalline areas.

6) Environmental factors

Temperature, moisture, salts, pH, and oxygen are required for the biodegradation process. Water is necessary for the growth of microorganisms. Polymeric materials can be biodegraded only under certain humidity and temperature has a dual effect on biodegradation.
The pH value also has a great effect on the growth of microorganism. Optimal pH can increase microbial metabolism, eventually, speed up the degradation rate.

The ideal requirements of denture base material represents by the followings:

1. Natural appearance.
2. High strength, stiffness, hardness and toughness.
3. Dimensionally stability.
4. Tasteless, odorless, non toxic and none irritating the oral tissue.
5. Insoluble in saliva or other fluids taken in to the mouth.
6. Good retention to polymer, porcelain and metals.
7. Easy to fabricate and Easy to repair.

8. Good shelf life.
9. Low density.
10. Accurate reproduction of surface details.
11. Resistance to bacterial growth.
12. Good thermal conductivity.
13. Easy to clean
14. Inexpensive to use
15. The softening temperature should be higher than mouth temperature.