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Bioplastic: An Alternative to Plastic Pollution

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SUMMARY

Now a days the petroleum based plastics were replaced by biobased plastics. When compared to normal plastics, the bioplastics are having much greater water vapour permeability. There is a high amount of carbon dioxide and many different kinds of toxic chemical compounds were released during the degradation of plastic and process of degradation is also difficult. Natural microorganisms such as bacteria, algae, and fungi will be capable of degrading plastic of bio origin. In recent years, these environmental/economic problems and social concerns have triggered developing environmental friendly materials such as bioplastics.

INTRODUCTION

Proteins, lipids and polysaccharides are known as natural polymers, from this Bioplastics or biodegradable films will be generated (Limpan et al, 2010; Rhim & NG, 2007). Generally microorganisms are responsible for the production of bioplastics (Luengo et al, 2003) and they are made from different resources such as sugars, potatoes and corn (Karana, 2012). One of the most innovative environmental friendly materials developed recently is bioplastics. Every year around 20% to 25% of the global bioplastics market is growing. Energy efficiency, eco-safety and lower carbon footprint, are some of the advantages of bioplastics (Arikan and Ozsoy, 2015). In the 21st century Bioplastics are the novel materials and would be of great importance to the materials world (Mohanty et al, 2002).

History of Bioplastic

- 1862 – The first man made biobased plastic is Parkesine which made from cellulose by Alexander Parkes.
- 1897 – German scientists invented the Galalith. It is developed from casein and Galalith is biodegradable plastic. Now a day's most of the buttons are made by Galalith.
- 1926 – From the Bacillus megaterium bacterium polyhydroxybutyrate (PHB) was developed by Maurice Lemoigne. PHB was the first bioplastics made from bacteria.
- 1912 – Wood, cotton or hemp cellulose is raw materials for the manufacturing of Cellophane (transparent sheet) and which is invented by Brandenberger.
- 1930s – Bioplastics were made by Henry Ford from soy beans for some car parts.

In the late 80s, Anthony Sinskey and his colleagues from Massachusetts Institute of Technology (MIT) successfully isolated thiolase enzyme which plays an important role in the production of bioplastics through biological process.

Why bioplastic?

One of the major threats to our environment is Synthetic Plastics. In every year more than 3 crore tons of plastic was generated by United States alone, from which only 10% of that figure being recycled. More than three hundred million metric tons of plastic is generating annually. The statistic shows that 44 % of sea bird species, 43% of marine mammal species and 86 % of sea turtle species are susceptible to ingesting marine plastic debris worldwide. The human beings have been unconsciously creating a new ecosystem in the ocean from the last few years, known as 'The plastisphere'. The hazardous substances are leak in to the environment because the microbes of plastisphere breaking down huge masses of polypropylene and polyethylene. Plastics derived from crude oil, depends more on scarce fossil fuels. The carbon dioxide is releases into the environment when plastics made from petroleum are burned and leads to global warming and they are Non –degradable in nature.

Types of Bioplastics

1) Starch-based plastic

Storage polysaccharide of cereals, legumes and tubers i.e. starch is the main source of bioplastic, which is renewable and widely available raw material for the production of bioplastic. Plasticizer addition and application of mechanical and thermal energy develops the thermoplastic starch (TPS) and that will be used as an alternative for polystyrene. Starch based plastic accounts for 41% of total bioplastic consumption.

2) Poly lactic acid (PLA) plastics

It is derived from the fermentation of agricultural byproducts such as starch-rich substances like maize, wheat, or sugar and corn starch. The process involves conversion of carbohydrate sources into dextrose followed by fermentation into lactic acid. PLA is the first biobased polymer commercialized on a large scale. PLA has replaced HDPE, LDPE and PS as packing material. PLA accounts for 47% of the total bioplastic consumption.

3) Cellulose based Plastic:

Cellulose bioplastics are mainly the cellulose esters such as cellulose acetate and nitrocellulose and their derivatives, including celluloid. Cellulose can become thermoplastic when extensively modified. It is a biodegradable polysaccharide from which cellophane film can be made by dissolving it in a mixture of sodium hydroxide and carbon disulphide to obtain cellulose xanthate which is then dipped into sulphuric acid to yield cellophane film.

4) Genetically modified or naturally occurring organism-based bioplastic

Starch and glucose is processed by certain bacteria to produce commonly used polyesters such as polyhydroxyalalkanotes (PHA) and poly hydroxybutyrate (PHB).

Organisms for PHA production; *Bacillus* spp., *Pseudomonas* spp., *Cupriavidus* spp., Azotobacter and *Robdobacter* spp.

Organisms for PHB production; *Bacillus* spp., *Pseudomonas* spp. *Vibrio* spp., and *Aeromonas* are found to be more efficient for PHB production due to their higher stability and reproducibility under environmental stress.

5) Polycaprolactones:

Polycaprolactones (PCL) is biodegradable polyester with a low melting point of around 60°C. These are crude oil-based chemically synthesized biodegradable thermoplastic polymer. Possess good water, oil and chlorine resistance and are used in thermoplastic polyurethanes, resins for surface coating adhesives and synthetic leather and fabrics.

6. Polyamide 11

A biopolymer derived from natural oil is polyamide 11 (PA 11). This polyamide bioplastic is also known under the trade name Rilsan. It is used in high-performance applications such as automotive fuel lines, pneumatic airbrake tubing, electrical anti-termite cable sheathing, oil and gas flexible pipes and control fluid umbilical's, sports shoes, electronic device components and catheters.

CONCLUSION

When the earth is going too filled up with plastics, Bioplastic is the correct alternative for that along with ecofriendly approach and many future scopes in hi-tech applications due to advancement in biotechnology. The future scope of bioplastic lies with several advanced application like in drug delivery system, stem cell technology, 3D printing etc. So it’s our duty to save our earth by saying No to plastic by using this sustainable Bioalternative. This article gives readers to a basic idea about bioplastics and their uses.

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