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Bio Polymer – Eco Friendly Packaging

Gattu Sriharika*, Pendram Kavya[1] and Anshul Kumar Verma[2]
*M-Tech, Department of Post Harvest Engineering, BCKV, Mohanpur - 741252, West Bengal, India
[1]M-Tech, Department of Processing and Food Engineering, Dr.RPCAU, Pusa – 848125, Bihar, India
[2]M-Tech, Department of Processing and Food Engineering, Dr.RPCAU, Pusa – 848125, Bihar, India

ARTICLE ID: 007

Abstract

The manufacturing and usage of conventional plastics in packaging industries are increasing day by day in all sectors. Conventional plastics are non degradable which has an undesirable effects on the environment like polluting water, degrading air and land qualities, causes problems with waste consumption and deposition. Bio degradable polymers or Bio polymers are degradable plastics which are produced from biomass, microorganisms, synthesized from monomers and with materials which are composed in soil without effecting environment.bio degradable plastics are recyclable, eco-friendly, non toxic, reducing CO2 emission and reduces plastic wastages. This article provide overview of bio polymers or bio – degradable plastics includes types of materials used for production of bio degradable plastics, Applications, Advantages and Disadvantages of bio- degradable plastics.

Introduction

Globally, the manufacturing, production, and usage of plastics are increasing year after year in many industries, most notably in the packaging industry. Nearly 96 - 99% plastic materials are manufactured from synthetic plastics like polyethylene, polystyrene, polypropylene etc. Plastics have low heat conductivity, well isolated, versatile and water resistant (Napper and Thompson, 2019).The usage of plastic packaging is necessary for protection, contamination, production, storage, distribution and for other unit operations.

Synthetic plastics, on other hand, are resistant to physical, chemical, and biological degradation, resulting in an increase in waste (Vert et al., 2002). Plastics waste became one of the global challenges. When the plastic waste is burnt, toxic chemicals and gases will be released which are harmful to environment and human life.

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In many industrial applications, Bio degradable plastics have emerged as a viable alternative to reduce the danger posed by non degradable plastics. Over time the biodegradable plastics will decay naturally because Biodegradable plastics made from renewable biomass.

Plastics made from renewable raw materials such as cellulose, bioethanol, starch, and lignin are often utilized in biodegradable goods (Steven et al., 2020). Polylactic acid (PLA), poly (hydroxy alkenoates) (PHA), poly (hydroxybutyrate) (PHB), poly (hydroxybutyrate-co-valerate) (PHBV), and poly (hydroxy valerate) (PHV) are the most prevalent biodegradable and commercially accessible natural polymers. Due to their persistence, biodegradable polymers can be biodegraded without generating any detrimental impacts. Biodegradable polymers are increasingly being employed efficiently in a variety of industrial and environmental activities.

Various biodegradable biopolymers are employed for a variety of packaging applications. There are three types of natural biodegradable polymers, according to their source:

- Biomass products such as starches and lignocellulosic materials,
- Polymers derived from microbes, such as poly hydroxyalkanoate (PHA),
- Polymers derived from renewable resources, such as polylactide (PLA)(Taofeeq et al., 2022)

Bio degradable forms:

1. **Films: -** Among five forms, films are most widely used form of biodegradable packaging in any industry. For replacement of polyethylene (PE), biodegradable films were designed. When comparison with PE, biodegradable films have better properties. The Better packaging film characteristics are:
   1) Preventing or reducing microbial growth
   2) To preserve structural integrity
   3) Excellent barrier characteristics
   4) Controlled respiration possible.
2. **Containers: -** For packaging of fruits, salads and vegetables thermo foamed containers or trays are used because to sustain the quality of such food products atmosphere should be controlled. The major properties of biodegradable containers are brittle and moisture resistant. Shelf life will be maintained same in both biodegradable trays and polyethylene

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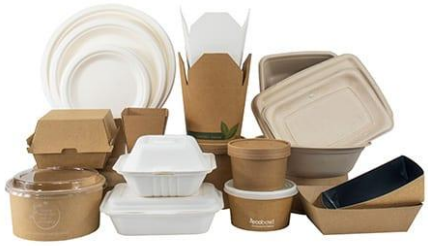
trays but using biodegradable trays can reduce effect on environment (Chonhenchob et al., 2007).

3. Foamed products: - Starch based applications are used for loose fill application, coatings are required for packing food product through direct contact. For the formation do foamed products there are various techniques they are extrusion transfer molding, loose fill molding, foam extrusion, and expandable molding. Landaal packaging system developed a Green Cell foam alternative to polypropylene foams which degrades completely in 24 days (Sustainable Packaging 2018).

1) Films



2) Containers

3) Foamed products

4) Bags

5) Gels

4. Bags:-Biodegradable bags have largest usage in food industries because their composition of raw material makes them moisture resistant, environment change resistant, un tearable, flexible and strong. These are completely environment friendly and once they composed completely they convert to carbon dioxide, water and other products. Instead of polyethylene, biodegradable bags are used.

5. Biodegradable gels

Hydrogels are also included in biodegradable gels and used to resist microbial contamination.The mixture of hydrogels with various polymeric materials reduces the shelf-

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life of some fruits, mostly due to water migration from the surrounding environment (Garcia and Barrett, 2002).

Bio Degradation

Biodegradation is the action of microorganisms that converts polymers into carbon dioxide, water, or methane and biomass.

Flowchart of biodegradation of polymeric materials:

Bio deterioration

(biodegradable material is breakdown into tiny fractions)

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Depolymerization

(enzymes that splits the molecule and form oligomers, di-mers, and monomers)

↓

Recognition

(some fragmented oligomers, di-mers, and monomers are identified by receptors of microbes, they send the plasma membrane of the microbial cell)

↓

Assimilation

(Molecules enter the cytoplasm and interact with the metabolism, producing a plethora of primary and secondary metabolites)

↓

Mineralization

(Some metabolites, such as organic acids and aldehydes, are released by microbial cells and enter the extracellular environment in form of carbon dioxide (CO_2), water (H_2O) and methane (CH_4))

Landfills method:

For recycling of biodegradable plastics there is one technology is Landfill-biodegradable means It is a true biodegradable approach in which the plastic contains an organic additive that speeds up the rate at which plastics biodegrade by allowing naturally occurring bacteria to consume the plastic in a landfill environment, resulting in biogas and humus (natural fertiliser).

Advantages

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- Biodegradable plastics are easily recyclable.
- Less energy consumption during their manufacture.
- Amount of waste produced will be reduced.
- Composting of biodegradable products can make the soil fertile, thereby improving soil fertility.
- Their decomposition produces CO2, only as much that had been used up in producing them.
- Emission of Greenhouse Gas Levels reduces.
- After decomposing, biodegradable plastics products do not set free harmful products.
- Biodegradable plastics products are naturally decayed by bacteria.

Disadvantages

- Biodegradable products get at a higher cost and this is the most critical barriers to the biodegradable plastics industry.
- Biodegradable plastics are produced from plants such as soybeans and corn. Therefore, there is a contamination risk as the crops are generally sprayed with pesticides when on the farm and can be transferred or included in the end product.
- Costly equipment is required for both recycling and processing.
- Biodegradable plastics may releases methane in landfills.
- Because the ocean waters are too cold for decomposition, these types of plastics cannot decompose. As a result, these plastics will either float on the water or degrade into micro-plastics, posing health risks to marine life.
- To produce biodegradable plastics, requires more crops and croplands.

Conclusion:

At present only 1-2% of biodegradable plastics are in use, if every industry steps forward to manufacture and use the biodegradable polymers the environment pollution will be reduced. So, the manufacturing of biodegradable polymers should be encouraged and the usage of non biodegradable polymers should be reduced.

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