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BIODEGRADABLE POLYMERS: AN ALTERNATIVE SOLUTION TO CONVENTIONAL POLYMER

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Abstract
Many researchers are modifying traditional materials to make them more user-friendly and designing novel polymer composites out of naturally occurring materials.There has been a marked increase in interest in biodegradable materials for use in packaging, cosmetics, agriculture, medicine, and other areas. As a result, a number of biological materials may be incorporated into biodegradable polymer materials with the most common being starch and fiber extracted from various types of plants.
Therefore, by combining the individual advantages of starch and synthetic polymers, starch-based completely biodegradable polymers (SCBP) are potential for applications in biomedical and environmental fields.
The biodegradable polymers are ecofriendly thus reduce the pollution,by reducing the need for synthetic polymer production at a low cost, thereby producing a positive effect both environmentally and economically. This research paper is explored a brief outline of biodegradable polymer research, synthesis and applications.
Keywords: biodegradable polymers, starch, Ecofriendly, Cosmetics, biomedical etc.

Introduction

Biodegradable polymers are a newly emerging field. In developing countries, environmental pollution by synthetic polymers has assumed dangerous proportions. As a result, attempts have been made to solve these problems by including biodegradability into polymers through slight modifications of their structures.

Developments in science and technology, especially over the last two decades, have increased the amount of synthetic polymers produced worldwide each year. Each year approximately 140 million tones of synthetic polymers are produced .The presence of these substances in the environment brings about important problems, including a challenge to wastewater treatment plants and pollution of groundwater and surface water. Another problem is disposal of agricultural plastic wastes. Especially for agricultural plastic wastes, an alternative method of disposal is biodegradation. Biodegradation concerns specially designed so-called biodegradable polymers. Increasing amounts of synthetic polymers produced results in increasing interest in polymer biodegradation. The recent incorporation of biological waste treatment in an integrated approach to solid waste management has resulted in a growing commercial interest in the development of biodegradable materials for consumer products. Biodegradable materials have the proven capability to decompose in the most common environment where the material is disposed, within one year, through natural biological processes into non-toxic carbonaceous soil, water or carbon dioxide.

Categories Of Starch Based Polymer

1. Thermoplastic starch products
- Thermoplastic starch biodegradable plastics (TPS)
- Have a starch (amylose) content greater than 70%.
- Based on vegetable starch, and with the use of specific plasticizing solvents, can produce thermoplastic materials with good performance properties and inherent biodegradability.
- This can be overcome through blending, as the starch has free hydroxyl groups, which readily undergo a number of reactions such as acetylation, esterification and etherification.

2. Starch synthetic aliphatic polyester blend
- Blends of biodegradable synthetic aliphatic polyesters and starch are often used to produce high quality sheets and films for packaging by flat-film extrusion using chill-roll casting or by blown film methods
- Approximately 50% of the synthetic polyester (at approximately $4.00/kg) can be replaced with natural polymers such as starch (at approximately $1.50/kg), leading to a significant reduction in cost.
- Furthermore, the polyesters can be modified by incorporating a functional group capable of reacting with natural starch polymers

3. Starch PBS/PBSA polyester blends
- Polyesters that are blended with starch to improve material mechanical properties

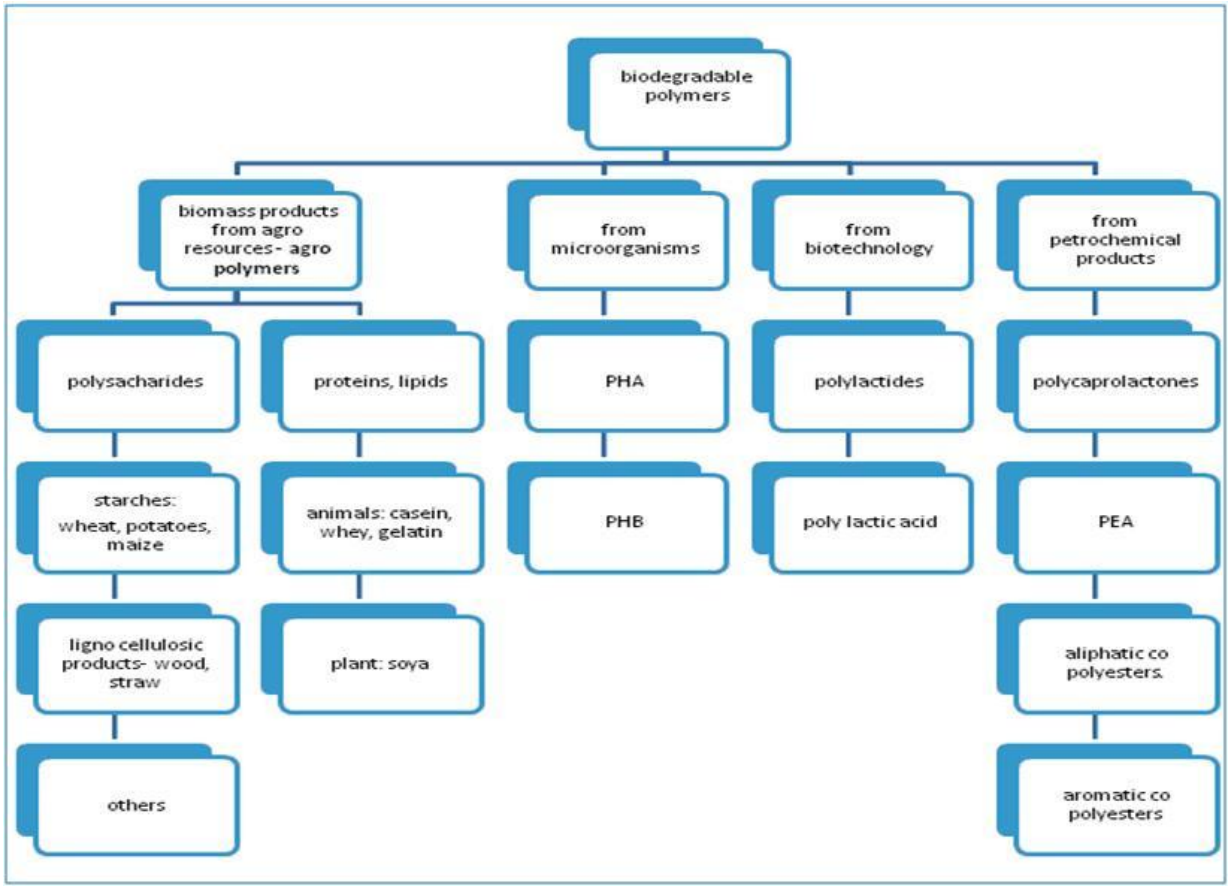
are Polybutylene succinate (PBS) or polybutylene succinate adipate (PBSA).

- At higher starch content (>60%), such sheets can become brittle.
- Plasticizers are often added to reduce the brittleness and improve flexibility.
- Starch and PBS or PBSA blends are used to produce biodegradable plastic sheet, which can be thermoformed into products such as biscuit trays or film products

4. Starch PVOH blends.

- Polyvinyl alcohol (PVOH) is blended with starch to produce readily biodegradable plastics.

Classification Of Biodegradable Polymers



Biodegradation

Process by which organic substances are broken down by the environmental effects and by the living organisms.

- Organic material can be degraded aerobically or anaerobically.
- Biodegradable matter is generally organic material such as plant,animal matter and other substances originating from living organisms,.
- Biodegradable polymers are a kind of materials which degrades biologically.

The biodegradability of polymer is dependent on the chemical structure of the material and on the constituent of the final product.

Mode of Biodegradation

The biological environment, i.e. the biological surroundings in which polymers arepresent, includes the biological agents responsible for the deterioration of polymeric substances.

Biological agents such as bacteria, fungi and their enzymes consume a substance as a food source so that its original form disappears. Under appropriate conditions moisture, temperature, and oxygen availability, biodegradation is a relatively rapid process.

Degradation Scheme

Degradation

An irreversible process leading to a significant change of the structure of a material, typically characterized by a loss of properties, such as integrity, molecular weight, structure or mechanical strength, into a product easily eliminated by the body metabolic pathway.

Degradation may be by: 1) chemical means or 2) Physical means

CHEMICAL DEGRADATION

- Chemical changes occur in polymer which includes cleavage of covalent bonds hydrolysis ionization or protonation either along the back bone or side chains of polymers.
- Chemical degradation leads to the change in molecular weight or solubility of polymer.

PHYSICAL EROSION MECHANISM

(A) **Bulk-eroding system**

(PLA,PGA,PLGA, PCL)

- Degradation takes place throughout the whole of the polymer matrix.
- Loss of physical integrity.
- Ingress of water is faster than the rate of degradation

(B) Surface-eroding system

(poly(ortho)esters and polyanhydrides)

- Eroded from the surface
- Physical integrity maintained
- Mass loss is faster than the ingress of water into the bulk

Major Disposal Enviornment For Biodegradable Polymers

- Composting facilities or soil burial
- Anaerobic digestion
- Wastewater treatment facilities
- Plastics reprocessing facilities
- Landfill
- Marine and freshwater environments
- General open environment as litter.

Market Analysis of Biodegradable Material

The technology surrounding biopolymers and biodegradable packaging has been in the development stage for the last 15-20 years. In the last five years have markets developed and much commercial growth been seen. Only few companies are currently producing biodegradable packaging materials on a large enough scale to be commercially successful.

Applications:-

1. Packaging-

Several polysaccharide-based biopolymers are being used as possible coating material or packaging films. They include starch,pullulan and chitosan. PLLA-based packagings under consideration include grocery and rubbish bags, diaper backings, six-pack rings and fast food containers.

2. Agriculture-

Agricultural Mulches :- Biodegradable films based on starch with poly(vinyl alcohol), poly(ethylene-*co*-acrylic acid) and poly(vinyl chloride)

Controlled release of agricultural chemicals: - .Starch,cellulose,chitin,alginic acid,and lignin

Agricultural planting containers: - polycaprolactone

3. Medical field-

Wound management : Sutures, Surgical meshes

Orthopedic devices :- Rods ,Screws Staples, Adhesives, Ligaments, Pins

Tissue engineering

Dental applications: Guided tissue regeneration Membrane, Void filler following tooth extraction

Cardiovascular applications : Stents,

Drug delivery system

Conclusion

Biodegradable polymers are one of the most innovative materials being developedin the packaging industry. Companies cannot work fast enough to produce this highly valuable technology. How widespread biodegradable polymers will be used all depends on how strongly society embraces and believes in environmental preservation. There certainly are an abundant amount of materials and resources to create and fund more uses for biodegradable plastics or polymers. The advancement of biodegradable technology has skyrocketed in recent years and there are growing signs that the public shows a high amount of curiosity in the product. With the variety of biodegradable polymers available in the near future, there will be a place for them current Age of Polymers.

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