Blends of Biodegradable Polymers and evaluation of their applications

Dr.C. Madhavi[1] and T. Sailaja Rani[2]
[1]Lecturer in Microbiology, Government College (A), Ananthapuramu
[2]Lecturer in Chemistry, Government College (A), Ananthapuramu
Email: chavva88@gmail.com

Abstract- Recently, attention has been drawn to the use of bio-reinforced composites in automotive, construction, packaging and medical applications due to increased concern for environmental sustainability. There is a possibility to control environmental pollution with the increasing use of biopolymers for the green economy. Thus, there has been considerable interest in the commercial exploitation of these biodegradable polyesters. Physical blending is a route to prepare biodegradable materials with different morphologies and physical characteristics. Recently different studies have been reported concerning the use of nanoclay with biodegradable polymers, especially with starch and aliphatic polyesters. Nano-biocomposites or bio-nanocomposites are under investigation. This paper reviews current applications of different biopolymers, and prospects in different fields..

Index terms: Environmental sustainability ; Physical blending ; biodegradable materials; biopolymers; current applications

I. INTRODUCTION

Biodegradable materials with plastic or elastomeric properties are in great demand for a variety of applications. Mixing biopolymers or biodegradable polymers with each other can improve their intrinsic properties. The polymer blend is alternative materials that have been produced with desirable properties based on available polymers rather than to design and synthesize a new polymer. For these reasons, the demands for polymer blend are really high in the market.

Biodegradable polymers have received much more attention in the last decades due their potential applications in the fields related to environmental protection and the maintenance of physical health. At present only few groups of the mentioned biopolymers are of market importance. The main reason is their price level, which is not yet competitive. The future of each biopolymer is dependent not only on its competitiveness but also on the society ability to pay for it. The future outlook for development in the field of biopolymers materials is promising. A product hazard for the environment is assessed by estimating the degree of its degradation and depends on the time needed for its complete mineralization, i.e. its oxidation to CO2 and H2O (biodegradation).

Polymers, bioproducts, bioplastics:

Polymers are natural or synthetic compounds structured as chains of repeating basic molecular units (monomers). They are classified as macromolecules, due to their high molecular weight. Schematically, the polymeric macromolecules can be divided into:

• Natural polymers, such as proteins composed of amino acids

• Synthetic polymers, traditional plastics such as polyethylene and polyvinyl chloride

• Biopolymers, such as, PHA.

Cellulose, starch and chitin, proteins and peptides, DNA and RNA are all examples of natural polymers produced by living organisms. The term “biopolymer” (or "bioplastic") is actually used as synonym of bioplastic but two different criteria underline its definition: the source of the raw materials and the biodegradability of the polymer.

According to these criteria it is possible to differentiate between three types of biopolymers:

(1) Biopolymers that are made from renewable raw materials (bio-based) and are biodegradable.

(2) Biopolymers that are made from renewable raw materials (bio-based) and are not biodegradable.

(3) Biopolymers that are made from fossil fuels and are biodegradable.

Furthermore, the bioproducts composed by biopolymers can be divided into two broad groups, namely biodegradable and non-biodegradable, or alternatively, into bio-based and non-bio-based bio-products.

Starch-based blends:

Starch is totally biodegradable and is an environmentally friendly material. In addition starch has a low cost. Nevertheless, since starch is highly sensible to water and has relatively poor mechanical properties compared to other petrochemical polymers, its use is limited. A solution may be to blend it with other synthetic polymers. Many biodegradable starch-based thermoplastic blends have been developed and studied extensively. A lot of research work deals with the development of blends of starch with synthetic biodegradable polymers. These blends present several advantages. The material properties can be adjusted to the needs of the application by modifying the composition.

These kinds of blends are intended to be more biodegradable than traditional synthetic plastics.

- Starch-poly(ethylene-co-vinyl alcohol) (EVOH)
- Starch-polyvinyl alcohol
- Starch-PLA
- Starch – PHB:

PHB or PHBV:

PHB or PHBV are brittle polymers. To improve their mechanical properties they are mixed with other biodegradable materials. When nucleating agents are added, smaller spherulites are formed, thus the mechanical properties are improved. In addition these properties depend on the processing conditions, morphology, crystallinity and glass temperature transition . Another class of biodegradable PHB can be prepared by blending a basic PHB with cellulose esters . Blends of PHBV and cellulose acetate butyrate were prepared by thermal compounding. The thermal process did not induce transesterification, nor molecular weight changes. The structure and mechanical properties depended on the PHBV content. When the PHBV content is lower than 50%, blends are amorphous, while with a higher content they become semi-crystalline. At this high content PHBV is partially miscible with cellulose acetate butyrate. These authors also studied blends of cellulose acetate propionate with poly (tetramethylene glutarate). A range of 50 to 90% wt of cellulose acetate propionate was investigated. The same process was used. The blends are amorphous.

II. APPLICATIONS OF BIOPOLYMERS BLENDS

Medicine and pharmacy: Biodegradable polymers are also used as implantable matrices for the controlled release of drugs inside the body or as absorbable sutures. Chitin and its derivatives have been used as drug carriers and anti-cholesterolemic agents, blood anticoagulants, anti-tumor products and immunoadjuvants .

Agriculture: Biodegradable polymers can be used for the controlled release of agricultural chemicals. The active agent can be dissolved, dispersed or encapsulated by the polymer matrix or coating, or is a part of the macromolecular backbone or pendent side chain. The agricultural chemicals concerned are pesticides and nutrients, fertilizer, pheromones to repel insects. The natural polymers used in controlled release systems are typically starch, cellulose, chitin, aliginic acid and lignin. PHBV has the unique property of being piezoelectric. It is used in drug carriers and tissue engineering scaffolds.

Packaging: In order to reduce the volume of waste, biodegradable polymers are often used. Besides their biodegradability, biopolymers have other characteristics as air permeability, low temperature sealability and so on. Biodegradable polymers used in packaging require different physical characteristics, depending on the product to be packaged and the store conditions.

Several polysaccharide-based biopolymers such as starch, pullulan and chitosan, have been investigated as packaging films.

Others fields:

Biopolymers are also used in shape specific applications such as in the automotive, electronics or construction sectors.

Electronics: PLA and kenaf are used as composite in electronics applications

Construction: PLA fiber is used for the padding and the paving stones of carpet. Its inflammability, lower than that of the synthetic fibers, offers more security. Its antibacterial and antifungal properties avoid allergy problems. The fiber is also resistant to UV radiation.

Biotechnological applications: Chitin acts as an absorbent for heavy and radioactive metals, useful in wastewater treatment.

V. RESULTS AND DISCUSSION

Polymer blend is an alternative polymer to substitute a common polymer used in industries. It acts same as the others polymer. The resource to make polymer blend is from the natural polymer. The combination of natural polymer and other polymer is called polymer blend.

VI CONCLUSION

In this review various applications of Polymer blend s are discussed, covering areas such as medicine,, pharmacy, Agriculture , Packaging, Others fields: Electronics, Construction, and Biotechnology field. The future markets for biopolymers are significantly increasing due to its sustainability. The biotechnology of microorganism gives a new hope to bioplastic production could significantly influence the production to compete with current barriers.

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