Issues related to Biodegradable polymer and Biopolymer

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Abstract: In these days pollution is taking the form of a disaster. There are various factors promoting the pollution one of them factor is pollution by use of non-biodegradable polymer which contribute to 43% in India. It is clear that use of non-biodegradable polymer is not eco-friendly but its substitution by biodegradable polymer is very slow. Factors behind it are higher cost and lack of initiatives. The purpose of this paper is to provide an overview of types of biodegradable polymer its economic & environmental importance in relation to biopolymer.

Keywords : Biodegradable Polymer, Economic Importance, Non-Biodegradable Polymers, Bio-Polymer

Introduction :

Polymer such as polysaccharides (starch, cellulose), proteins and nucleic acid which control the various life process as are all these polymers disintegrate by themselves in biological system during a certain period of time by enzymatic hydrolysis and to some extent by oxidation/light and hence are biodegradable as a result they do not cause any pollution.

As a known fact, sustainability requires that a degradable material breaks down completely by natural processes so that the basic building blocks can be used again by nature to make a new life form polymer made from petrochemicals are not a product of nature and cannot be broken down by natural processes hence the use of biodegradable is the need of the hour to implement immediate application for biodegradable polymer.

It has shown that plastic bags are preferable to paper bags throughout their life cycle due to lower energy needs for production and environmental pollution. There are significant advantages or disadvantages of bags produced from one type of plastic over those made from other kinds of plastic, including recyclable material. Furthermore, comparison with the paper bag alternative, which is accepted by the public as the 'greener' choice, reveals that the paper bag uses almost 10 times as much material as that needed to produce a single use plastic bag. The production process also requires the use of cellulose derived from trees an important environmental resource for sequestering greenhouse gasses. Moreover, the process of producing paper bags demands the use of larger volumes of water than plastic bags and the degradation process of paper bags in landfills releases greenhouse gasses. No difference was found between plastic and biodegradable bags in references to the problems associated with a whole life cycle, and both these alternatives are preferable to the paper bag alternative.

Bio-Polymer

So far the paper and board sector has been by far the largest bio-polymer producer. Its world wide production amounted to approximately 365 million metric tonnes (Mt) in 2006. Non-food starch (excluding starch for fuel ethanol), cellulose polymer and alkyd resins are also important bio-polymers but they are much smaller in terms of production volumes. In total, they account for approximately 20 Mt/yr. of that non-food starch takes the lion's share (75% or 15 Mt), followed by cellulose polymers (20% or 4 Mt, excluding paper) and alkyd resin (5% or 1 Mt)

Bioplastics (Biopolymers) obtained from growth of microorganisms or from plants that are genetically-engineered to produce such polymers are likely to replace currently used plastic at least in some of the fields. The global interest in PHAs is high as it is used in different packaging materials, medical devices, disposable personal hygiene and also agricultural applications as a substitute for synthetic polymers like polypropylene, polyethylene etc.

Types of biodegradable & degradable polymer

Compostable polymer : Degradation of a plastic by biological processes through composting to yield inorganic compounds, CO2, water an biomass at a rate constant with other recognized compostable materials and depart no. noticeable, apparent or toxic residue.

Photodegradable/Oxo=degradable plastics : Photodegradable/Biodegradable plastics break up into small pieces when out in the open to sunlight (due to addition of a sun-sensitive factor to the plastic to activate degradation). Revert is family of oxo-biodegradable polymer.

Biopolymers are classified according to their renewability substances (fully or partially bio-based or oil-based). Another attempt to classify biodegradable polymers into two main groups as shown in FIG. 2 is, i) the agro-polymers gained by biomass fragmentation processes (polysaccharides, proteins, etc.), and ii) the bio-polyesters gained either by synthesis from bio-derived monomers (poly-lactic acid-PLA) or by extraction from microorganisms (polyhydroxy-alkanoate – PHA) or by synthesis from synthetic monomers (poly-capro-lactone-PCL, aromatic and aliphatic copolyesters – PBAT, PBSA, etc.)

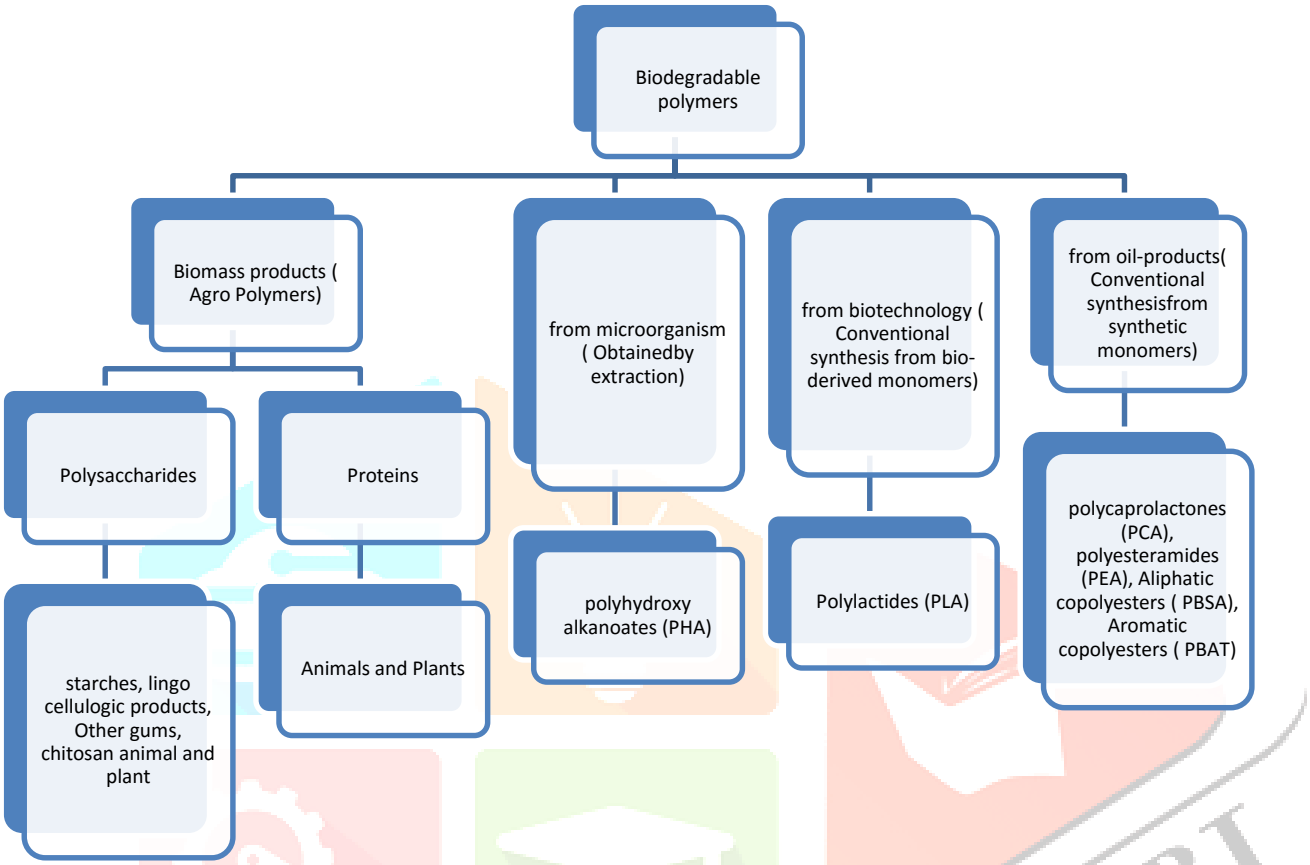

FIG No. 1: Classification of biodegradable polymers.

The range of biodegradable plastics existing includes :

- Starch based products including thermoplastic starch, starch and synthetic aliphatic polyester blends, and starch and PVOH blends.
- Naturally produced polyesters including PVB, PHB and PHBH.
- Renewable resources polyesters such as PLA.
- Synthetic aliphatic polyesters including PCL and PBS.
- Aliphatic-aromatic (AAC) co-polyesters.
- Hydro-biodegradable polyester such as modified PET.
- Water soluble polymer such as polyvinyl alcohol.
- Photo-biodegradable plastics.
- Controlled degradation additive master batches.

Natural Polymers

A wide variety of naturally occurring polymers were known to humans. The natural polymers comprise four broad groups : 1. Polysaccharides – Starch, Cellulose, 2. Proteins – Gelatin, Casein, Silk, Wool, 3. Polyesters-Polyhyroxyalkanoates, 4. Others- Lignin, Shellac, Natural Rubber.

Synthesized biodegradable polymers :

There are sources of polymers produced from petrochemical or biological resources that are biodegradable synthetic resins. The list includes : polyalkylene esters, polylatic acid and its copolymers, polyamide esters, polyvinyl esters, polyvinyl alcohol and polyanhydrides.

Blends of natural and synthetic polymers :

This is low cost procedure to make biodegradable packaging materials by blending of natural polymers in to improved mechanical properties. The generally target for preparing an advanced blend of two of more polymers is not easy because the properties of compound will not change drastically, but capitalize on the maximum possible performance of the blend. Gutta-percha or 1, 4- trans polysoprence is a natural polymer having several applications, as compared to endodontic filling material. Starch is also one of the most important natural polymers because it has implicit biodegradability. Blends of natural-synthetic polymers have been considered promising for preparing polymers with "tailor-made" properties. In case of polymer we can apply 4-R means Reduce, Reuse, Recycle & Reverte.

Some Biodegradable packaging material & their manufacturing company.

Table No. 1

Sr. No.	Biopolymer	Manufacturing company
1	PHB/PHU	Biomer, UK.
2	Starch based bland	Biotec, Germany., Earth Shell, USA.
3	Cellulose acetate	Courtaulds, USA., Mazzucchelli, Italy.

Economic importance of Biodegradable polymer :

Bio-based polymer represent an emerging, very dynamic field with a very positive development potential for the future. Bioplastics development is just beginning. Their market share is currently well under one percent. The market is growing and in many application areas e.g. packaging or agricultural films, the number and quantity are increasing dramatically. Today, the combined volume of the non-food non-plastics applications of starch and man-made cellulose fibers is 55 times larger than the total volume of the new bio=based polymers. The new bio=based polymers may reach this level in 20-30 years from now. The use of starch for paper production only amounts to 2.6 Mt and is hence still seven folds larger than today's word wide production of bio-based plastics. By 2013, the world-wide capacity of bio-based plastics could increase to 2.3 Mt and by 2020 to 3.5 Mt. starch is inexpensive (about 10 cents/Ib) and is available annually in multimillion ton quantities from corn produced in excess of current market needs in the United States.

Bio-based and biodegradable plastics are a very promising innovation for both industry and the economy. The recommended products, that may be made out of compostable/biodegradable plastics, are Agricultural Mulch Film, Nursery Bags, Garbage bags/ Wet Waste Disposal Bags, Special Food Wraps, Coating on Paper /Jute/Textile, specialized fishery items, plastic water bottles to be carried during expedition in mountains, cutlery to be carried in boats/ships/trains, foam packaging products medical sector etc. Bioplastics sector registers continuous growth : As estimated by IBAW, pan-Europen consumption of bioplastics in 2003 was at 40000 tons. This indicates that consumption has doubled from 2001.Especially in Great Britain, Italy and the Netherlands the market development was dynamic.

Conclusion :

Biodegradable polymer create some environmental risks, where the conditions required for full degradation are not met and consequently no complete degradation. Effective education is required with the opening of biodegradable plastics into the consumer packaging market. It is important for public to be acquainted with biodegradable plastics that even they do not degrade instantaneously and hence circumvent the potential to increase the incidence of littering. Hence, novel technologies should be employed in future for complete biodegradation of the biodegradable materials. Catalysts like proteases, esterase, glycosidase, and manganese peroxides and also, presence of microbes can be employed in order to have complete biodegradation. Therefore, there is a scope to do research on biodegradation of biodegradable. Biopolymer with some structural modification can solve the global problem of plastic waste management.

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