A Review on Bioplastics: Applications and Current Scenario

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Abstract— The objective of this briefing paper is to provide a concise summary of some of the key issues surrounding the biodegradability of plastics in the oceans, and whether the adoption of biodegradable plastics will reduce the impact of marine plastics overall. One of the principal properties sought of many plastics is durability. This allows plastics to be used for many applications which formerly relied on stone, metal, concrete or timber. There are significant advantages, for food preservation, medical produce, electrical safety, improved thermal insulation and to lower fuel consumption in air craft and automotive. Unfortunately, the poor management of post-use plastic means that the durability of plastic becomes a significant problem in mitigating its impact on the environment. Plastics are ubiquitous in the oceans as a result of several decades of poor waste management, influenced by a failure to appreciate the potential value of 'unwanted' plastics, the under use of market-based instruments (MBIs), and a lack of concern for the consequences (GESAMP 2015). Present paper discusses current scenario in the use and research going in the field of bio degradable plastic.

Keywords: Bioplastics, Applications

I. Introduction

Bioplastics encompasses a whole family of materials which are bio based, biodegradable, Milk is used as raw material because it has high level of casine protein a nature polymer and good forming properties. Bio based means that the material or product is (partly) derived from nature. Raw material from nature used for bioplastic from e.g. cow milk. The term biodegradable depicts a chemical process during which microorganisms that are available in the environment convert casein from milkinto natural substances such as water, carbon dioxide and compost. The process of biodegradation depends on the surrounding environmental conditions, on the material and on the application.

The term 'plastic', as commonly applied, refers to a group of synthetic polymers .Polymers are large organic molecules composed of repeating carbon-based units or chains that occur naturally and can be synthesized. Different types of polymers have a wide range of properties, and this influences their behavior in the environment. There is considerable debate as to the extent to which plastics intended to be biodegradable do actually biodegrade in the natural environment. This extends to the peer-reviewed scientific literature but is most intense between those organizations that can be thought to have a vested interest in the outcome, such as the producers of different types of plastics, the producers of additive chemicals intended to promote degradation and those involved in the waste management and recycling sectors. Conventional agricultural plastic films have an enormous environmental impact in terms of CO_2 emissions during their life-cycle.

Improvement of soil and product quality: Conventional agricultural films present toxic components and contaminate the soil in a number of ways. Multi-biosol bioplastics will not only avoid these harmful components, they also will add value through Oligo Elements (trace minerals as natural fertilizers) and micro-perforation functionalities that contribute to agriculture à la carte and help improve the health of the soil and the quality of the final product.

II. Production

Production of bioplastics starts with the collection of starch material plants, which produce them by absorbing Carbon di oxide during photosynthesis. This plant starch is fermented by using lactobacillus bacteria, and is converted into a long-chain carbon polymer (PLA). These PLA granules are then molded into small plastic pellets which are melted to make different kinds of objects and packaging material. On the other hand, Polyhydroxylalkanoate is a polyester produced by fermenting raw vegetable materials such as carbohydrates, vegetable oil or even glycerine. bacterial strains. It is specially extracted from bacteria such as pseudomonas.

A. Uses of Bio Plastic

Bioplastics are plastics in which all carbon is derived from renewable feed-stocks. They may or may not be biodegradable. Biobased plastics contain both renewable and fossil-fuel-based carbon. The percentage of biobased ingredients and the conditions under which the biobased product may biodegrade, if at all, vary widely. Some common applications of bioplastics are packaging materials, dining utensils, food packaging, and insulation. Products on the market are made from a variety of natural feed-stocks including corn, potatoes, rice, tapioca, palm fiber, wood cellulose, wheat fiber and bagasse. Biodegradable bioplastics are used for disposable items, such as [packaging] and catering items (crockery, cutlery, pots, bowls, straws). They are also often used for bags, trays, containers for fruit, vegetables, eggs and meat, bottles for soft drinks and dairy products, and blister foils for fruit and vegetables.

B. Effects of Biodegradable Plastic

Littering is fundamentally a problem of irresponsible behaviour, which should be tackled by changing people's attitudes rather than by changing the products they are throwing away. Making products biodegradable may actually make the problem of littering worse, by making people think that it is OK to throw away valuable resources like plastics. For example, a biodegradable plastic bag that's thrown into a hedge will still take years to disappear, rather than days as some people believe. Even a banana skin - when thrown away - needs 1-3 years before it is biodegraded!

What's more, biodegradable plastics require specific conditions to biodegrade properly (micro-organisms, temperature, and humidity), and if not managed properly they may be worse for the environment than conventional plastics. When biodegradable plastics are put into landfill (which should always be avoided in any case) they produce harmful greenhouse gases when breaking down.

What are biodegradable plastics? Biodegradable plastics are plastics that can be broken down by microorganisms (bacteria or fungi) into water, carbon dioxide and some bio-material. It is important to note that biodegradable plastics are not necessarily made from bio-material (i.e. plants). Several biodegradable plastics are made from oil in the same way as conventional plastics.

Non-biodegradable substances are those which cannot be transformed into harmless natural state by the action of bacteria. And burning of these fuels causes more pollution in the environment. They can be useful if recycled. Ex: plastics, glasses, metals, toxic chemicals, toxins, grocery bags, plastic containers, and plastic water bottles.

C. How to Decompose Biodegradable Plastic

Biodegradable plastics take three to six months to decompose fully. That's much quicker than synthetic counterparts that take several hundred years. Exactly how long a biodegradable bag takes to break down depends on various factors, such as temperature and the amount of moisture present. But the bags aren't always as environmentally friendly as they seem. They're made from similar petrochemical-based materials to conventional plastic, only with compounds added that cause them to disintegrate gradually in the presence of light or oxygen. They often then degrade into a sludge of toxic chemicals.

Bioplastics made of cornstarch and other plant-based materials are a better bet. They give off Carbon di oxide as they decompose, but they're merely expelling carbon locked in by the plant matter that originally formed them. The net effect on the environment is therefore close to zero.

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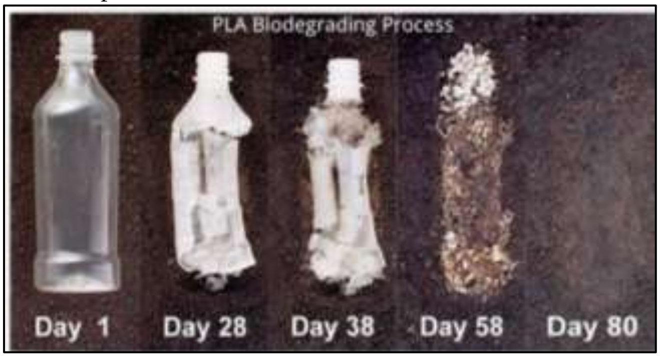

D. Environmental benefits

There is much debate about the total carbon, fossil fuel and water usage in manufacturing bio plastics from natural materials and whether they are a negative impact to human food supply. To make 1 kg (2.2 lb) of polylactic acid, the most common commercially available compostable plastic, 2.65 kg (5.8 lb) of corn is required. Since 270 million tons of plastic are made every year, replacing conventional plastic with corn-derived polylactic acid would remove 715.5 million tones from the world's food supply, at a time when global warming is reducing tropical farm productivity. Although U.S. corn is a highly productive crop, with typical yields between 140 and 160 bushels per acre, the resulting delivery of food by the corn system is far lower. Today's corn crop is mainly used for biofuels (roughly 40 per cent of U.S. corn is used for ethanol) and as animal feed (roughly 36 per cent of U.S. corn, plus distillers grains left over from ethanol production, is fed to cattle, pigs and chickens). Much of the rest is exported. Only a tiny fraction of the national corn crop is directly used for food by Americans. Much of that is for high fructose corn syrup. Traditional plastics made from non-renewable fossil fuels lock up much of the carbon in the plastic, as opposed to being burned in the processing of the plastic. The carbon is permanently trapped inside the plastic lattice, and is rarely recycled, if one neglects to include the diesel, pesticides, and fertilizers used to grow the food turned into plastic.

E. Distinguishing "Biodegradable" from "Compostable"

In typical parlance, the word biodegradable is distinct in meaning from compostable. While biodegradable simply means an object is capable of being decomposed by bacteria or other living organisms, "compostable" in theplastic industry is defined as able to decompose in aerobic environments that are maintained under specific controlled temperature and humidity conditions. Compostable means capable of undergoing biological decomposition in compost site such that the material is not visually distinguishable and breaks down into carbon dioxide, water, inorganic compounds and biomass at a rate consistent with known compostable materials.

The inclusion of "inorganic materials" precludes the end product from being considered as compost, or humus, which is purely organic material. Indeed, under the ASTM definition, the only criterion needed for a plastic to be called compostable is that it has to appear to go away at the same rate as something else that one already knows is compostable under the traditional definition.

Plastic bags can be made "Oxo-biodegradable" by being manufactured from a normal plastic polymer or polypropylene incorporating an additive which causes degradation and then biodegradation of the polymer (polyethylene) due to oxidation.

III. Recycling Process

In-plant scrap can often be recycled, but post-consumer sorting and recycling is difficult. Bio-based polymers will contaminate the recycling of other more common polymers. While Oxo-biodegradable plastic manufacturers claim that their bags are recyclable, many plastic film recyclers will not accept them, as there have been no long-term studies on the viability of recycled-content products with these additives. Further, the Biodegradable Plastics Institute (BPI) says that the formulation of additives in Oxo films varies greatly, which introduces even more variability in the recycling process. SPI Resin identification code 7 is applicable.

Until then bio-based plastics which are not drop-ins will normally go to waste incineration plants which allow the recovery of energy. In comparison to fossil based plastics, the CO_2 from incinerated bio-based plastics was recently captured and will be captured again when new bio-based products will be produced. CO_2 from fossil based plastics was captured a long time ago and therefore contributes to an increase of greenhouse gas concentration in the atmosphere.

Organic vegetables and fruit in supermarkets are often packaged in biodegradable plastic. Plant pots and magazine wrappers are also often biodegradable. The logo of a sprouting leaf on the packaging shows that this plastic is compostable. The definition of the logo is that the material should disappear completely within seven weeks in an industrial composting unit which runs at up to 65 degrees Celsius. The material is broken down into natural resources by bacteria. But if you add this biodegradable plastic to your own compost, the natural biodegrading process can take two years.

IV. STRENGTHS

- High profitability and revenue
- Low operational cost
- Accessibility to the target markets
- Availability of raw material

V. WEAKNESSES

- Low capital intensive industry attracts new entrants
- Inadequate technical expertise
- Awareness

VI. OPPORTUNITIES

- By using effective marketing strategies this business can attract more growers and traders
- Growing market demand
- Environmental benefits

VII. THREATS

- Competition by other business adversaries
- Government regulation and pricing policies

VIII. USE OF BIODEGRADABLE WASTE

Biodegradable waste can be used for composting or a resource for heat, electricity and fuel by means of incineration or anaerobicdigestion. Swiss Kompogas and the Danish AIKAN process are examples of anaerobic digestion of biodegradable waste. While incineration can recover the most energy, anaerobic digestion plants retain nutrients and make compost for soil amendment and still recover some of the contained energy in the form of biogas. Kompogas produced 27 million Kwh of electricity and biogas in 2009. The oldest of the company's Lorries has achieved 1,000,000 kilometers driven with biogas from household waste in the last 15 years.

Biodegradable waste includes any organic matter in waste which can be broken down into carbon dioxide, water, methane or simple organic molecules by micro-organisms and other living things by composting, aerobic digestion, anaerobic digestion or similar processes. In waste management, it also includes some inorganic materials which can be decomposed by bacteria. Such materials include gypsum and its products such as plasterboard and other simple organic sulphates which can decompose to yield hydrogen sulphide in anaerobic land-fill conditions.

IX. ADVANTAGES OF BIO PLASTICS

1) Bioplastics don’t generate as much toxic run-off.
2) Oil based plastics need fossil fuels and bio-plastics don’t
3) Reduce Carbon di oxide emission-It takes only 0.8 metric tons of Carbon dioxide to create bio-plastics which is 3.2 metric tons less than normal plastics.
4) Low Emission of Green House Gases.
5) Limited Utilization of fossile fuels.
6) bioplastics is that they're compostable: they decay into natural materials that blend harmlessly with soil.
7) Carbon Emission Reduction
8) Consumes Less Energy
9) Less Landfill Area Needed
10) Recyclable

X. DISADVANTAGES OF BIO PLASTICS

1) First we need to define bio plastic. A bio plastic is any plastic that is made from or by biological sources. So bio plastics can be made of polymer sources from things such as cellulose, starch, chitin, gluten, even plant oils. Being bio plastic doesn’t necessarily mean that the plastic is readily biodegradable or compostable. Very stable plastic such as polyethylene and PET can be made from biological sources as well as from fossil fuel products.
2) Biodegradable plastics are those that are broken down by biological processes, such as by bacteria or fungi. Although all plastics are biodegradable under the right conditions of heat, time, UV light and the presence of suitable organisms, to be classified biodegradable plastic must meet different standards in different countries.
3) The same can be said with compostable plastic and compostable is broken up into further categories of those that are backyard compostable and those that need industrial composting facilities. Even when plastic is completely compostable in your backyard compost that still doesn’t mean that it will break down quickly in the ocean or fresh water. Thus all bio plastic may still have negative impacts on freshwater and marine animals.
4) Need for Composters
5) Engineering Issues
6) Risk of Contamination

XI. POPULAR VARIANTS OF BIOPLASTICS

Unknowing to us, Bioplastics have been around for decades now with a notable historical usage in the Model T automotive parts that were designed by Henry Ford from corn starch and soybean oil ingredients. However, it needs to be noted that not all bioplastics are completely biodegradable. Some biological-based products can biodegrade in municipal composting facilities, or aquatic and landfill environments, others can only biodegrade in very specific environments, while some will not biodegrade at all. There are two variants that have become more popular and have gained maximum attraction:

1) Polylactic acid (PLA) – transparent solid polymer that is similar to PETE polymer, but has a significantly lower maximum continuous use temperature
2) Poly hydroxyl alkanoate (PHA)- is much more eco-friendly polymer that can handle high temperatures and

decomposes in soil and waterways as well Both these variants are primarily manufactured from fermented corn sugar and they can decompose up to 90% within 90 days if disposed properly. In fact, bioplastics can anaerobically degrade and release methane in the presence of moisture, which can be captured to be used for energy production.

XII. Bioplastic Companies in India

The market for bioplastics in India is no longer nascent with many industry players taking pioneering steps. Our country has the raw material biomass required for bioplastics in abundance. Combining this with the rising awareness among consumers, India could become the potential fulcrum for global behavior change in turning away from plastics. Quite a few manufacturing firms like Envigreen, Ecolife, Plastobags, Earthsoul India and Truegreen have come up with different forms of bioplastics, which are already supplying these environment friendly forms of plastics in regional markets.

XIII. Name of Companies in Bioplastics Field in India

A. Truegreen

Truegreen is a firm based out of Ahmedabad that started a manufacturing plant with a capacity of producing 5,000 tons of bioplastics every year. The company offers a large variety of packaging solutions with bioplastics in the form of cutlery, garbage bags, food gloves, shrink films and other packaging and laminating materials made out of bioplastics, which are fully biodegradable in 180 days

B. Plastobag

Plastobags is an established company that primarily started in the business of conventional plastics but recently has diversified its product portfolio and expanded into bioplastics with a whole range of products from carry bags, hygiene gloves to disposable waste bags and security bags. suitable for garden needs, they also have bioplastics for food packaging and waste disposal purposes.

C. Ecolife

Ecolife is a firm based out of Chennai that produces bioplastics for industrial packaging. Their products also include bioplastics for industrial packaging with different varieties like perforation films and lamination films. The bioplastics produced by Ecolife do not contain polyethylene or poly propylene

D. Envigreen

Envigreen is the latest start up entering the Indian bioplastics market established by a Qatar-based NRI, Ashwath Hegde. In 2016, Envigreen opened its operations in Bengaluru and its production facility is already capable of producing 1,000 tons of bioplastics every year. The carry bags manufactured by Envigreen are made out of 12-14 biological ingredients like potato, tapioca, organic oil extracted from banana, flowers and other vegetables along with natural starch.

XIV. Conclusion

From present review it is clear that plastic debris is ubiquitous in the marine environment, comes from a multitude of sources and is composed of a great variety of polymers and copolymers, which can be grouped into a relatively limited number of major classes. Polymers most commonly used for general applications, with the required chemical and mechanical properties (e.g. PE, PP, PVC) are not readily biodegradable, especially in the marine environment. Polymers which will biodegrade in the terrestrial environment, under favourable conditions (e.g. AcC, PBS, PCL, PES, PVA), also biodegrade in the marine environment, but much more slowly and their widespread use is likely to lead to continuing littering problems and undesirable impacts. Biodegradable polymers tend to be significantly more expensive. Their adoption, in place of lower-cost alternatives, for well-justified purposes (e.g. key components of a fishing trap) The high biodegradable reliability and the strong polymerization of the milk casein-based biodegradable plastic raw material would able to replace the plastic, styrofoam, and polystyrene containers in this century. The less time consuming of the biodegradation of the bioplastic product can substantially help to cover up the defect before and leaving green environment.

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