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GREEN PLASTIC: A NEW PLASTIC FOR PACKAGING

Mr. Pankaj Kumar*, Sonia
Assistant Professor, Department of Printing Technology, GJU S&T, Hisar
Scholar, M.Tech, Department of Printing Technology, GJU S&T, Hisar

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ABSTRACT

This paper gives a brief idea about a new type of plastic called as bio-plastic or green plastic. Plastic is used as a packaging material for various products, but this plastic is made up of non renewable raw materials. There are various disadvantages of using conventional plastic like littering, CO2 production, non-degradable in nature etc. To overcome these problems a new type of plastic is discovered called bio-plastic or green plastic. Bio-plastic is made from renewable resources and also reduces CO2 emission upto a great extent. Today various types of bio-plastics are available in market like PLA (Poly lactic acid), PHA (Polyhydroxylalkanoate), PE (Polyethylene), PCL (Polycaprolactone) etc. Soon various industries will start using bio-plastic because of various advantages of bio-plastic over conventional plastics.

KEYWORDS: Bio-plastics, Bio-degradable, Carbon Footprint, Conventional Plastic, Renewable Resources, Food packaging, Non-Renewable resources.

INTRODUCTION

Plastic is most versatile material used for packaging and its use is growing more and more. Conventional plastic, which are being used is made up of petroleum based raw materials. As we all know, petroleum is non renewable material and it is limited in stock. Use of conventional plastic creates various environmental issues like green house gas emission, littering, non-degradable waste generation etc. To reduce these problems a new type of plastic is invented named as bio-plastic or green plastic. Bio-plastic is a material which is fully or partly made from biomaterials such as sugarcane, potato, plant oil, corn starch etc. and degrades automatically in soil and water without any artificial additives. In modern era, demand for green plastic is growing more and more due to its advantages over conventional plastics.

TYPE OF BIO-PLASTICS

Bio-plastics are used from past two or three decades, the use of bio-plastics is increasing rapidly due to its advantages over conventional petroleum based plastics. Today, most of the plastics are being replaced by bio-plastics like Poly lactic acid, Polyhydroxylalkanoate, polyethylene, etc. Following are three categories of bio-plastics:

1. Bio-based
2. Bio-degradable
3. Bio-based and bio-degradable

Bio-based

This type of plastic is made from renewable resources like corn starch, sugarcane, hemp etc. These resources are unlimited in stock in nature. This plastic is made up of agricultural based raw material, CO_2 emission is also less as compared to conventional plastic. Some examples of bio based plastics are PE **(**Polyethylene), PET (Polyethyleneterephthalate) and PA (Polyamide)

PE (Polyethylene)

Bio-based polyethylene is identical to conventional polyethylene in physical and chemical properties. Raw material used for bio-based polyethylene is agricultural feed stock such as sugar cane, corn etc. CO_2 gas emission per kg is less in polyethylene as compared to conventional polyethylene. Properties and applications of bio-based polyethylene and conventional polyethylene are almost same. Bio-based PE is a better option for applications where we require longer life of product.

Polyamide (PA)

Polyamide is a bio-plastic derived from vegetable oil. It is produced from castor beans but it is not bio-degradable in nature. Polyamide has superior thermal resistance, water resistance, chemical resistance, appearance, heat resistance, dimensional stability and also has low environmental impact. Polyamide bio-plastic is low in cost and thus it is used in production of electrical cables, automotive industries and packaging industries. Polyamide is used in many areas where safety, durability and versatility are important.

Bio-degradable

A plastic, which is made from conventional raw material and degrades automatically in the environment without any additional additives called bio-degradable plastic. This type of plastic is used for one time use packages. This plastic degrades within few days to few months according to environmental conditions. There are some bio-plastics which are biodegradable in nature like PBAT (Poly-butyrate adipate-terephthalate), PCL **(**Poly-Caprolactone) etc.

Poly Caprolactone (PCL)

It is a bio-degradable plastic derived from crude oil and not from renewable resource. It is a biodegradable plastic. Caprolactone have properties like good water, oil and solvent resistant. Its melting point is low and ranges from 58 to 60(°C). Caprolactone is used for short life applications.Low melting point of caprolactone makes it suitable for composting as a means of disposal. Degradation time is also less.

Bio-based and biodegradable

There are some bio-plastics which have property of both bio-based and biodegradable plastics like PLA (Poly lactic acid), PHA (Polyhydroxylalkanoate) etc.

Poly lactic acid (PLA)

It is a bio-degradable plastic derived from agricultural resources like sugar cane, potato, tapioca roots, chips etc. Poly lactic acid is second highest consumable plastic in modern era. Because of its degradable nature, poly lactic acid has many applications. It is completely degradable under the compost conditions. Poly lactic acid is not water soluble in nature. Carbon footprint reduction in poly lactic acid is very high. One kg of conventional plastic will produce 6 kg CO_2 but one kg of poly lactic acid will produce only 1.8 kg CO_2. Poly lactic acid is used where we needs a product for longer life span.

Polyhydroxylalkanoates (PHA)

It is linear polyester produced by bacterial fermentation of sugar and lipids. This plastic is bio-based and biodegradable in nature. Agricultural raw materials are used in the manufacturing of poly hydroxylalkanoatebio-plastic. Mechanical and bio-compostable property of poly hydroxylalkanoate can be changed by mixing polyhydroxylalkanoate with other plastic and thus increasing its field of application. Polyhydroxylalkanoate can be produced easily by conventional processing tools. Poly hydroxylalkanoate has the property of UV stability.

ADVANTAGES OF BIO-PLASTICS

Bio-plastic is growing more and more due to its extraordinary feature in packaging industry. Use of bio-plastic is increasing day by day. These plastics have following advantages over petroleum based plastics.

Unlimited raw material

As these plastics are made from agricultural raw materials, which grow on yearly basis. So there is no shortage of raw materials as compared to conventional plastics raw material.

Bio-degradable
Biodegradable bio-plastic takes lesser time to degrade after being thrown as garbage. So, it does not require any recycling, basically it reduces land filling problem upto a great extant as compared to conventional plastic.

Requires less energy for production
Bio-plastics need less than half of the energy for production as compared to conventional plastics. It means, we can produce double amount of bio-plastic using the same amount of energy.

Reduces dependency on foreign oil
Use of bio-plastics reduces the dependency on foreign oil, which is the main raw material for conventional plastics.

Non-toxic in nature
Conventional plastics are made up of harmful chemicals, which releases harmful gases during its breakdown process but bio-plastic are completely safe and do not have any chemicals or toxins as it is manufacture by natural sources.

Eco-friendly
Bio- plastic is eco-friendly in nature. There are very few greenhouse gases and less carbon emission is generated during the production and incineration process of bio-plastics.

CHALLENGES FOR BIO-PLASTIC

Misconceptions
Public at large do not understand about bio-plastic related terms and definitions like bio-based plastic are biodegradable or not, fossil plastics are biodegradable or not etc. Many times bio-plastic related slogans are being misused by various manufacturers to sell their products in market. All these confusion may claim a pause to peoples to purchased bio-plastics.

More costly
As we know that market of bio-plastic is very small till now. Cost of bio-plastic is almost double as compare to conventional plastic. So people prefer to use conventional plastics due to its reasonable cost.

Recycling problem
Recycling of bio-plastic is one of the biggest challenges that industry is facing in the growth of bio-plastic. Not all types of bio-plastics are recyclable. Different bio-plastics require different recycling process because during recycling bio-plastics cannot be mixed together. For example if a small quantity of PLA bio-plastic is mixed into PET bio-plastic in the recycling process, the resulting plastic will be of poor quality.

Lack of government support
According to different surveys, it is estimated that use of bio-plastics will increases up to 6.7 million tons by 2018. But in many countries government do not take any strict action for rules and regulations about the production, usage and waste management of bio-plastics.

Limited supply of chemicals
Chemicals used in bio-based plastics are limited and supply of these chemicals is less, so that is a big challenge in growth of bio-plastics.

APPLICATIONS OF BIO-PLASTIC

Demand for bio-plastic is growing more and more. Today we are using bio-plastic in many of packaging industries like food packaging, bulk packaging, cosmetics packaging, drugs packaging, automobile industry, textile industry etc. Following are the applications of bio-plastic in different industries:

Bio-plastic in Food Industry

Figure [1] Vegetable Packaging

Figure [2] Water Bottles

Figure [3] Fruits Packaging

Food industry is one of the main application areas of bio-plastic. Food products are packed in pouches for one time use. After using the products, empty pouches are thrown away as garbage. If we use conventional plastic it does not degrades upto 100 of years and create littering and other garbage problems. But when bio-degradable type of bio-plastic is used which degrades within few days to few months than littering and other environmental problems can be avoided. Bio-plastic have excellent barrier to oxygen, high transparency, good puncture resistance and non-toxic property, so it is used in many food packaging applications such as for baked food packing, sweets packaging, candies wrapper, biscuits wrapper, cold drinks and beverages bottles, fruits and vegetables packaging.

Bio-plastic in Cosmetics Industry

Figure [4] Shampoo Bottle

Figure [5] Hair Clip

Figure [6] Makeup product

Bio-plastic is used widely in cosmetics industry. As transparency is biggest concern in cosmetics industry, bio-plastic gives more transparency as compared to conventional plastics. So, now a day's every company has started using bio-plastics in cosmetics industry by replacing conventional plastics into bio-based biodegradable plastics, PHA (polyhydroxylalkanoate) plastic is one of the example of this type of plastic. Some applications of bio-plastics in cosmetics industry is in shampoo bottles, hand wash bottles, powder boxes, nail paint bottles, cream tubes, jewellery boxes, lipstick cover boxes, lip gloss, shampoo bottles, toothpaste tubes, perfume bottles.

Bio-plastics in Pharmaceutical Industry

Figure [7] Coffee Capsule Tube

Figure [8]Tablete Strip

Figure [9]Gloves

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There are many uses of bio-plastics in Pharmaceutical industry. Bio-plastics application in pharmaceutical industry offers great promise for healthier future. Bio-plastic is used widely in pharmaceutical industry for making various devices and artificial body parts which dissolves with in body without any harmful effect. Uses of bio-plastics are increasing day by day. In pharmaceutical and health industry two types of bio-plastic are being used, biodegradable type for one time usable instruments and bio-based biodegradable for reusable instruments. Some applications of bio-plastics in pharmaceutical industry is in pills bottles, bio-degradable stitches, syringes, tubes, bandage cover, gloves, medical instruments, artificial body parts etc.

Bio-plastic in Bulk Packaging

Figure [10] Bulk Packaging of Pickle

Figure [11] Bulk Packaging of Bottles

Packaging is a process in which product is packed into something to protect it from dirt, dust, environmental effects and supply it safely from one place to another. When a large number of products are packed together than that process is called bulk packaging. Bio-plastic have replaced conventional plastic from bulk packaging industry. Bio-based type of bio-plastic is used in bulk packaging industry. Some applications of bio-plastics in bulk packaging is for metal packaging (steel drums, barrels, and large cans), rigid packaging (plastic barrels, large bottles), flexible packaging systems (woven sacks, films for stretch wrapping, shrink wrapping), wooden packaging (pallets, cases).

Bio-plastics in Automobile Industry

Figure [12] Parts of Car

Figure [13] Part of Car

Use of bio-plastic in automobile industry is increasing rapidly. Bio-based bio-plastic is used in automobile industry for making different parts of vehicles. By using this type of plastic we can reduce the dependency on petroleum based conventional plastic and can also reduce carbon footprint because this type of plastic is made from agricultural raw material. Life of these plastics is also more. Weight of this plastic is about five to seven percent less as compared to conventional plastic which makes it lighter for use.

PRESENT SCENARIO OF BIO-PLASTICS

As conventional plastic creates a lot of environmental and health issues so, people are more interested in using bio-plastic as compared to conventional plastic. But till now market of bio-plastics is very small as compared to market of conventional plastic. Global market share of bio-plastic is only 5-7% of total plastic market. But demand of bio-plastic is increasing day by day. Today almost every second company is interested in using bio-plastics instead of conventional plastic. Market of bio-plastic in India is also very small that is only 2-3% of total plastic we are using in one year but it can be hoped to grow in future.
So, it is the start of Bio-plastics use, future is very prominent.

FUTURE FORCASTING OF BIO-PLASTIC

Future of bio-plastic is very bright. As we can see that bio-plastic is a special type of plastic which is made from renewable raw materials like maze, potato, wheat, plant oil, potato etc. and degrades without any artificial additives within few days. According to a survey report, production of bio-plastics is about 58690 kilo tones in 2015. And it is expected to grow 29.3% during the time 2016- 2020. Demand of bio-plastic is growing more and more as awareness among consumer is increasing with time. According to survey report, Asia pacific is growing fastest in rigid packaging. It is assumed to grow with 40% annually in 2015- 2020.

CONCLUSION

Bio-plastic is a good alternate to conventional plastic for packaging. Advantages of bio-plastic over conventional plastic includes cheap raw material, unlimited raw material supply, reduction of carbon footprint, easily degradation property and modify it better than conventional plastic. Bio-plastic and conventional plastic have same physical and chemical properties. According to application area required bio-plastic can be used like PE **(**Polyethylene), PET (Polyethylene terephthalate), PA (Polyamide), PBAT (poly-butyrate adipate terephthalatSe), PCL **(**Poly Caprolactone) etc. Application of bio-plastic is in food packaging industry, cosmetics packaging industry, pharmaceutical industry, automobile industry, bulk packaging industry which covers a major segment of packaging. From this paper this can be concluded that there are possibilities to widen the area of bio-plastic in packaging more research is needed to be in this field.

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