Bioplastic from Food Waste

Mr. Paras Jain[1] Mr. Aleem Khan[2] Mr. Rahul Gupta[3] Mr. Pankaj Malviya[4]
[1,2]Student [3,4]Assistant Professor
[1,2,3,4]Department of Chemical Engineering
[1,2,3,4]IIST, Indore, India

Abstract— So many different type of plastic are available in market, their properties, their impact, their production rate, that all type of factor are derive to make a good and beneficial plastic for us. Generally plastic are not naturally occurring. The lots of research and development to identify the material which has tendency to development same properties of material which have stability and durability of plastic material and easily decomposed and not any harm to environment. The depending the large number of requirement of plastic materials which fulfil our needs and easily carrying that material to use. The production rate of plastic in the world is about 100 million tonnes per annum and it is growing at 4% annum and in India too, at present time to see a large number of productions based on petro plastic polymer. That does not sustain on environment so we need to a new product that have bioplastic, same type of properties, durability, good efficiency and eco-friendly to sustainable plastic. The present research work on a Bioplastic material by using foods waste mainly banana peels, potato peels, papaya peels, corn starch or some other food and vegetable waste and confirms the polymer is Bioplastic. One of most significant result obtained during the research is degradation To use of Bioplastic material by using the food waste and vegetable waste depending on their structure and properties of materials the tractability of the biodegradation polymer are quite similar to ideal plastic and they can play a virtual role in this market for sustainable use and commercial value provided.
Key words: Banana Peel, Bioplastic, Biodegradation, Green Applications, Starch, Sustainable Use

I. Introduction

Most plastics are made from petrochemicals. Due to the large number of threat like global warming, Environmental issues, Human health, Aqvative life and many more. The development of bio material plastics is a growing field. When make some small and large parts materials to make use of plastic polymer. Bioplastic are made substantially from renewable plant materials such as cellulose and starch. According to analysis of data in 1960 the world produced 7 million tonnes of plastic. It's rapidly rise to 540 million tonnes by 2020. However, Bioplastic manufacturing begins from a very low base and does not comparing the petrochemicals product. When application of bioplastic are used for disposal items, such as packaging, crockery, cutlery, pots, bowls, and straws. And they could replace many applications for petroleum-derived plastics; however cost and performance remain problematic. Biopolymers are available as coatings for paper rather than the more common petrochemical coatings.

Plastic is synthetic material consisting of large number of synthetic or semi-synthetic organic compounds that malleable and so can be moulded into solid objects. The first fully synthetic plastic was Bakelite, invented in New York in 1907 by Leo Baekeland who joined the term 'plastics' many chemists have contributed to the materials science of plastics, including Nobel Laureate Hermann Staudinger who has been called "the father of polymer chemistry" and Herman Mark, known as "the father of polymer science".

Plastic starts more than 150 years ago, the manufacturing of plastic evolved from chewing gum, shellac. To use of chemical modification from natural rubber, nitrocellulose, collagen, galalite and finally to completely synthetic molecules like Bakelite, Epoxy, Polyvinyl chloride. In Plastic have property of all materials which can deform irreversibly without breaking but, in the mould able polymers, Plastics are typically organic polymers of high molecular mass and often contain other substances. They are usually synthetic, most commonly derived from petrochemicals. Different type of polymers use in different places, like in packing areas, building materials, automobiles many more. The developing country rapidly use of plastic their demanding as same in India too, consumption rate is high.

A. Classification of Plastic

1) Thermoplastic:

When heated, do not undergo chemical change in their composition and so can be moulded again and again.

Examples: polyethylene (PE), polypropylene (PP), polystyrene (PS) and polyvinyl chloride (PVC).

2) Amorphous Plastic and Crystalline Plastic:

Many plastics are completely amorphous, such as all thermosets polystyrene and its copolymers and polymethyl methacrylate.

3) Conductive Plastic:

Intrinsically Conducting Polymers (ICP) are organic polymers that conduct electricity. While plastics can be made electrically conductive, with a conductivity of up to 80 kS/cm in stretch-oriented polyacetylene.

4) Biodegradable Plastic:

Biodegradable plastics are plastics that degrade, or break down, upon exposure to sunlight or ultra-violet radiation, water or dampness, bacteria, enzymes or wind abrasion. In some instances, rodent, pest, or insect attack can also be considered as forms of biodegradation or environmental degradation.

II. Bioplastic

A Bioplastic is a substance made from organic biomass sources. Bioplastic are made through a number of different processes. Some use a microorganism to process base materials, such as vegetable oils, cellulose, starches, acids and alcohols. While almost all bioplastic produce less carbon dioxide in production than conventional plastics, they are not necessarily completely green. The methods by which their base materials are grown and the processing involved both impact their product footprint. Many bioplastic also release carbon dioxide or monoxide when biodegrading.

Nevertheless, their overall environmental impact is typically lower than that of conventional plastics, and as oil costs rise, their cost becomes more and more competitive. Some biodegradable bioplastic can break down in 180 days, given the right conditions. Others are not biodegradable at all. This capacity is desirable. Bioplastic, like petroleum-based ones, differ in make up to address different needs. The bioplastic used to make disposable cutlery, food containers, grocery bags, electronics casings and conductive bioplastic for electronics are all very different from one another. Bioplastic were mainly developed in an effort to find a replacement for conventional plastics whose problems include:

- They can take thousands of years to decompose.
- Plastics are a major contributor to landfills and pollution, and especially problematic to sea life.
- Conventional plastics are made from a non-renewable resource, petroleum, which is increasing in cost as it becomes more scarce.
- Toxic and carcinogenic chemicals are used in their production, such as bpa and many other plasticizers.
- Plastics have a large carbon footprint in both production and recycling.

A. Types of bioplastic

Most of bioplastic polymer they are contributing to the global food crisis. Many different types of bioplastic available in markets, which are made from maize, sugarcane, wheat, banana peels, papaya waste, potato starch and others. Bioplastic use such as sustainable, biodegrade able, compostable and recyclable and make carbon savings.

1) Starch-based plastics

Types- Corn starch, potato starch
Description- The characteristics of the resulting bioplastic also called thermo-plastic starch.
Examples- Packing bags, disposal, pharmaceutical sector.

2) Cellulose-based plastics

Types- Softwood trees as the basic raw material. Barks of the tree
Description- Ellulose plastic is anticipated to offer huge growth opportunity in cellulose ester market.
Examples- Electronics products such as transparent dialers, screen shields, etc

3) Protein-based plastics

Types- Protein sources
Description- Show promising properties as a raw material for different biodegradable polymers.
Examples- Gluten and casein

4) Polyamide 11

Types- Natural oil
Description- Emissions of greenhouse gases and consumption of non-renewable resources are reduced during its production.
Examples- Automotive fuel lines, pneumatic airbrake tubing, flexible oil and gas pipes, and sports shoes.

5) Bio-derived polyethylene

Types- Sugar cane or corn
Description- Bio derived polyethylene is chemically and physically identical to traditional polyethylene.
Examples- Building block (monomer) of polyethylene

6) Lipid Derived Polymers

Types- Plant and animal derived fats and oils.
Description- Types of polymers have been developed with comparable properties to crude oil based materials.
Examples- Polyesters, Epoxy resins

B. Experimental setup; Preparation methods of Bioplastic from food waste

For the preparing of bioplastic using the Banana peels. The most important food crops in the world. Bananas are a healthy source of fiber, potassium, vitamin B6, vitamin C, and various antioxidants and phytonutrients present. Bioplastic can be defined as plastics made of biomass such as banana peels. Bio plastic is plastic made of biodegradable materials such as banana peels, food waste. They are completely safe and do not have any harmful chemicals or toxins. Bio plastics can replace by petroleum based plastics.

III. Materials Required

Banana peel, Starch, Glycerol, hydrochloric acid (0.1M), sodium Hydroxide (0.5M), Distilled water, beaker, stirrer, measuring cylinder, Bunsen burner, Spatula, Grinder stone, Shredder, Oven, Measuring cylinder, Tea strainer, Tap water, Universal indicator, Food colouring.

A. Experimental Procedure

- Cuts the Banana peels into small pieces.
- Banana peels are boiled in hydrochloric acid for about 30 minutes (Fig 1.). It is used as antioxidant and preservative. This would increase the biodegradation period of bioplastic. The water is decanted from the beaker and the peels are now left to dry on filter paper for about 30 minutes. (Fig 2.)
- After the peels are dried, they are placed in a beaker and using a hand blender, the peels are pureed until a uniform paste is formed.
- 64g banana paste is placed in a beaker 6ml of (0.1) naoh is added to this mixture. And 5ml Glycerol is added according to ph desired.
- The mixture was poured into a Petri dish and put in the oven at 100°C-150°C maintain about 30 minutes. (Fig 3 and Fig 4)

Fig. 1: Banana peels on heating plate

Fig. 2: Drying banana peels

Fig. 3: Banana plastic film Petri dash

Fig. 4: Bioplastic Dry film

B. Potato starch

For the preparing of bioplastic using the potato starch. Bioplastic can be derived from many starch-based materials. Potato starch is very refined starch, containing minimal protein or fat. This gives the powder clear white colour. Its high binding strength, in this lab, we will make a plastic film from potato starch and test their properties. Potato starch is a polymer made of long chains of glucose units joined together.

C. Materials

Potato, Glycerine, Distilled water, Sodium hydroxide, Beaker, Stirrer, Hot plate, Spatula, Grinder stone, Shredder, Oven, Aluminium foil, Measuring cylinder, Tea strainer, Hydrochloric acid (0.1M), Universal indicator, Food colouring

D. Experimental Procedure

Firstly, take 100gm potato. The potato does not need to be peeled, but it should be washed from water.

- Put the potato into the hand blender and Grind the potato carefully add about 150 ml distilled water mixed.
- Pour the liquid off through the tea strainer into the beaker, leaving the potato behind in the mortar. Add 100 ml water, grind and strain twice more.
- Leave the mixture to settle in the beaker for 10 to 15 minutes.
- Pour off the water from the beaker, leaving behind the white starch which should have settled in the bottom. Add about 150 gm distilled water to the starch and stir gradually. Leave to settle again and then pour off the water, leaving the starch behind.

Extracting starch from potatoes takes a lot of energy is required. After extraction of potato starch

- Put 35 ml water into the beaker and add 4.5 gm potato starch, 5 ml hydrochloric acid, 5ml Glycerine and mixed properly.
- Heat the mixture using the Bunsen burner. Bring it carefully to the boil and then boil it gradually for 15 minutes. Make sure it does not boil to dry. If it looks like drying, then stop heating.
- Dip the glass rod into the mixture and dot it on to the indicator paper to measure the pH. Add enough sodium hydroxide solution to neutralise the mixture, testing after each addition with indicator paper.
- If you wish you can add a drop of food colouring reagent and mix slowly. Be careful not to spill the food colouring - it stains.
- Put the mixture on a Petri dish or white tile and push it around with the glass rod so that you have an even covering.
- Leave the mixture to dry out. This will take about two days at room temperature show in fig (5) and (6).

Fig. 5: Thickness of the potato plastic

Fig. 6: Potato starch based plastic

IV. Result and Discussion

- As a result it has higher efficiency of starch material because more polymer chains can be form easily. And less efficiency of the banana peels, as its efficiency is 90% while the efficiency of the banana peels is 80%. Although potato peels are available as much as banana peels, they weren't used because they require more time to dry after getting them out of the oven, as the banana peels require only 1 day, while the potato peels require at least 2-3 days to dry.
- The thickness of the plastic was determined by using a ruler.
- Strengths by applying a 4N pulling force on each of them from the opposite sides and determining whether or not the plastics broke.
- The biodegradation period was found to be 5-6 months. After 8 month there was degradation of bio-bag due to growth of micro-organism.

V. Conclusion

In experiment setup the Bioplastic from banana peels and potato starch that can be used as packaging or as carry bag. Sodium Meta bisulphate prevent growth of microorganism such as bacteria, Glycerol is added to increases its flexibility. The degradation of Bioplastic starts after 3 to 4 months from the date of production. The Bioplastic produced through this method could be substantial and the biodegradable tractability is one of the main challenges in developing Bioplastic material. The plastic sample produced may not achieving the ideal characteristic of a plastic, But it is good in biodegradability as it can be composted in just 3 days.

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