Production of Bio-Plastic from Natural Polymer and Polymer Blends

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Abstract— the recent study indicates that industrial sectors and researchers have had augmented interests in production of plastics that are bio based. There are several reasons that are attributed to this observation, some of which include the increase in the price of oil which eventually increases the prices of raw materials that are manufactured from petrochemicals (Tanrattanakul & amp; Saithai, 2009). This seeks to look into the production of bio plastics in the world today. Therefore this explains the concepts and technologies used to produce bio plastics. A critical analysis of bio plastics and how they are related to the environment will also be investigated in this project. There has been an increasing interest in application of bioplastics in the world today. This is attributed to the increasing prices in oil prices and the decreased supply for raw materials used to manufacture petrochemicals. Bioplastics are similar to traditional plastics in their application but the difference is that they are characteristic biodegradable in a specified composting cycle. This is attributed to the increasing prices in oil prices and the decreased supply for raw materials used to manufacture petrochemicals. Therefore a demand for products that are environmentally friendly. The impacts of global warming on the environment due to the continued production of conventional plastics have been an issue on the rise. This is especially in regard to the amounts of energy consumed and the effects of greenhouse in some specified areas. Bioplastics helps to offer a solution to the disposable problems in plastic application. This is because; they are biodegradable, meaning that they can be recycled and thus reused again. Most industries prefer the use of bioplastics raw materials compared to traditional raw materials. This is because of the advantages accrued with the use of these materials. An industry that produces bioplastics have a wide range of raw materials that are of high quality at a cheaper price and thus creating a competitive advantage.

Key words: Bio based, Bioplastic, Petro Chemical, Biodegradable, Global Warming, Greenhouse, Environmentally Friendly, Plasticizer, Starch, Elasticity

I. INTRODUCTION

Packaging waste forms a significant part of municipal solid waste as Oil based polymer is currently used in packaging applications In addition, Conventional plastics are non-bio-degradable thus, It is difficult to recycle or reuse due to complex composites while non- renewable source is used to production of conventional plastics, It takes 1 to 10 years to consume. Therefore, discarded plastics are a big cause of pollution, cluttering rivers, seas, and beaches, killing fish, choking birds and making our environment a much less attractive place.

Effects of plastic pollution on almost every sector of the earth are very malignant. Landfill areas are constantly piled with different types of plastics which are biodegradable in nature that causes land pollution and nutrients of soil to degrade. They also attack ocean by spilling significant amount of nurdles. They typically degrade within a year but not completely. The risk of leaching of chemicals into the ocean from plastics is still a burning issue. Marine • Plastic pollution has potential to poison animals. Marine species have been found to contain large proportions of plastic in their stomach. On the top of that, Chemicals used in the production of plastic have the potential to be absorbed by human through skin causing dermatitis or many other diseases.

Taking into consideration the above mentioned issues with the utilization of conventional plastic, bioplastics could help humans as a supreme alternative. They are derived from renewable sources and are readily bio degradable. Bioplastic do not produce dangerous chemicals while burnt in the open atmosphere. Bioplastic can be manufactured from natural raw materials i.e. Starch, Glycerin, Vinegar, Water, Acid, etc. Biodegradability properties enable game changing advantages such as a reduced carbon footprint or additional waste management operations through organic recycling.

II. OBJECTIVES

To prepare bioplastic from natural polymer initially we optimized concentration of acid which is followed by optimization of conc. of plasticizer (like agar-agar, cellulose acetate, STMP). Then we optimize process parameters (i.e. Temp, Time, pH). After study of natural polymer bland we find it's effective sensitivity to acid/ alkali, it's effect with weather conditions, physical strength (tensile strength, compressive strength) and Biodegradability test to conclude comparison between conventional (synthetic) plastic& bio-plastic.

III. ACTION PLAN

A. Raw Materials and Apparatus Required

100 ml tap Water, 10 gm Starch (corn, potato), 10 ml Glycerin, 10 ml acetic acid (50 % diluted) or 0.1N HCl, Plasticizer, Agar-Agar, Beaker, Stirring rod, Hot plate with magnetic stirrer, Measuring cylinder, Thermometer, Hot air oven, pH strip, Petri dish etc.

B. Brief about Raw Materials

1) Starch (corn or potato)

Chemical formula $(C_6H_{10}O_5)_n$. Starch is a carbohydrate consisting of a large no. of glucose units joined byglycosidic bonds. This polysaccharide is produced by most green plants as an energy store. Pure starch is a white, tasteless, odorless powder that is insoluble in cold water.

2) Glycerine

Glycerinecan also referred as a glycerol which is very useful plasticizer and is inexpensive.

3) Plasticizer

Plasticizers are additives that increase the plasticity or fluidity of a material. The dominant applications are for plastics, especially polyvinyl chloride (PVC).

4) Acetic acid

It is a liquid consisting mainly of acetic acid (CH3COOH) and water. The acetic acid is produced by the fermentation of ethanol by acetic acid bacteria. Historically, as the most easily available mild acid, it had a great variety of industrial, medical and domestic uses, some of which are still promoted today.

The combination of acetic acid and glycerin produce cellulose acetate which increase the compressive strength of bioplastic.

5) Water

Tap water is mainly used in the making of bioplastic consisting mainly low turbidity, pH is mainly 7-8 and TDS containing 50-60 mg/l.

C. Procedure of Forming Bioplastic from Corn Starch

Mix all these ingredients properly in a beaker Then put the beaker on hotplate with magnetic stirrer, stir the solution continuously. After sometime temp will increases and color change will occurs at 70^0 C. As temp increases furthermore color change takes place from white to transparent At 85^0-90 ^{0}C, it starts bubbling. Then spread the jelly evenly on the uniform surface. Then put it in hot air oven for drying for 1 hr. at 60^0 C. Finally, we get the bioplastic.

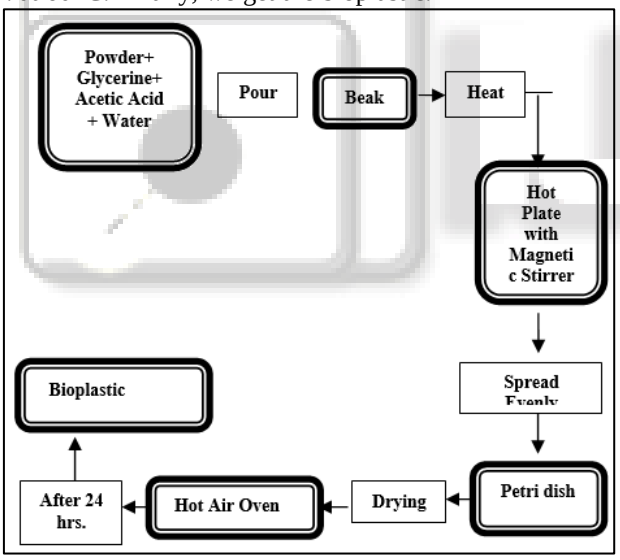

Fig. 1: Procedure of Forming Bioplastic from Corn Starch

1) Procedure with Different Plasticizers (with Gelatine)

- Water – 5 tbsp
- Corn starch – 1 tbsp
- Glycerin – 1 tbsp
- Vinegar – ½ tbsp
- Gelatin – ½ tbsp

Then keep this mixture in microwave oven for 3 minutes at 100°C.

After that kept it in the sunlight for UV radiation for proper drying around 5-6 hrs.

2) Procedure with Different Plasticizers (With Glyoxal)

- Water 100 ml
- Gelatine 6 gm
- Corn starch 6 gm
- Glycerine 10 ml
- Vinegar 5 ml
- Glyoxal 0.12 ml (1 % of starch)
- Drying for 2 hrs at 110°C in hot air oven.
- Curing or heat setting at diff. temp. in hot air oven.

3) Procedure with Different Plasticizers (with glutaraldehyde)

- Water 100 ml
- Gelatine 6 gm
- Corn starch 6 gm
- Glycerine 10 ml
- Vinegar 5 ml
- Glutaraldehyde 0.12 ml (1,2,4,6,8 % of starch)

Drying for 2 hrs at 110°C in hot air oven.

Curing or heat setting at diff. temp in hot air oven.

IV. MERITS AND DEMERITS

- It is produced from renewable resources.
- It does not contain toxins.
- Much less GHGs emission than conventional plastic production (reduction 86%)
- 65% less energy is needed to produce bio-plastic than conventional plastic.
- PLA plastic is competitive with conventional plastic.
- There is no longer danger of explosion in its production.
- PLA is compostable, but there are very few facilities where these can actually be done.
- Consumers will not compost starch based plastic properly.
- Polymer contain in corn based plastic makes regular compost more acidic.
- Some data used within the project was based on a series of assumptions and estimates.

V. OUR RESEARCH AND IT'S APPLICATIONS

A. Packaging

The use of bioplastics for shopping bags is already very common. After their initial use they can be reused as bags for organic waste and then can be composted. Trays and containers for fruit, vegetables, eggs and meat, bottles for soft drinks and dairy products and blister foils for fruit and vegetables are also already widely manufactured from bioplastics.

B. Catering Products

Catering products belong to the group of perishable plastics. Disposable crockery and cutlery, as well as pots and bowls, pack foils for hamburgers and straws are being dumped after a single use, together with food-leftovers, forming huge amounts of waste, particularly at big events.

C. Gardening

Within the agricultural economy and the gardening sector mulch foils made of biodegradable material and flower pots made of decomposable bioplastics are predominantly used due to their adjustable lifespan and the fact that these materials do not leave residues in the soil. This helps reduce work and time (and thus cost) as these products can simply be left to decompose, after which they are ploughed in to the soil. Plant pots used for flowering and vegetable plants can be composted along with gardening and kitchen litter.

D. Medical Products

In comparison to packaging, catering or gardening sectors, the medical sector sets out completely different requirements with regards to products made of renewable and reabsorbing plastics. The highest possible qualitative standards have to be met and guaranteed, resulting in an extremely high costs, which sometimes exceed 1.000 Euro per kilo. The potential applications of biodegradable or reabsorbing bioplastics are manifold.

E. Sanitary Products

Due to their specific characteristics, bioplastics are used as a basis for the production of sanitary products. These materials are breathable and allow water vapor to permeate, but at the same time they are waterproof. Foils made of soft bioplastic are already used as diaper foil, bed underlay, for incontinence products, ladies sanitary products and as disposable gloves.

VI. RESULT

Temp. (°C)	Time of curing (minute)	Film property after curing	Solubility in cold water		
			1 day	2 day	3 day
120	15	Elastic			
130	15	Elastic			
140	15	Less elastic than previous			
150	15	Less elastic			
160	15	Brittle			

Table 1: Result

VII. CONCLUSION

We have given our sincere efforts to this project work and we have performed experiments for getting desirable outcome. We are expecting that our project is completed in minimum 7-8 runs. The product has get proper strength as a conventional plastic and it will be equally elastic and flexible as conventional plastic. We are expecting that besides of physical strength, composting of bioplastic will be also occur in a fairly natural manner. The cost of conventional plastics are around 30 INR per kg while our biodegradable plastic costs around 45 INR per kg. The cost will decreases and even it can be less than conventional plastics if the production occurs in bulk. Because biodegradable plastic depends on temperature it is crucial to maintain the tmp. During production process. Thus we expect that this project will be considered as an important aspect in the bioplastic processing.

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