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MANUFACTURING OF BIO-PLASTIC FROM VARIOUS MATERIALS

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Abstract

Bioplastics are plastics obtained from renewable biomass sources, such as vegetable fats and oils, corn starch or microbiota. Bioplastic can be made from agricultural by-products. Now a day's disposal of plastic is the major problem. To avoid the harmful effect of plastic, bioplastic is the best alternative. The main objective is to compare the bioplastic from various material i.e. cornstarch and MSW (municipal solid waste). Also to study the effect of plasticizer on bioplastic.

Keywords : *Corn Starch ,Vegetable Fats, Micro-biota.*

1. INTRODUCTION

Currently the main source of producing polymer material is fossils (non-renewable). Along with the increased use of plastics the burden on the environment is also increasing, as plastic use is continuously increasing.

Day by day use of plastic is increasing and as per survey in year 2010 265million tones of plastic were produced world wide. And 74.2million from Asia [1].

There are two ways to reduce burden of plastic on environment.

- Reuse
- Recycle

To reduce these burden of polymers , the polymers which are bio-degradable or made from renewable sources are better alternative [1]. The first plastic which is claimed to be bio-degradable invented twenty years ago. When these plastic is introduced to the market it didn't bring immediate success. Because of poor summing up about there main bio-degradable property. But the characteristic was a greatest advantage.

1.1 Plastics Its Classification And Uses

Plastics are generally by-product of petroleum refining. Wehster dictionary defines plastic as "any of various complex organic compound produced by polymerization, capable of beingmoulded, cast into various shapes and films or drawn into filament and then used a textile fibres. The several reason for the popularity of plastics are [5]:

- Low cost
- Resistance to chemical, solar and microbial degradation.
- Thermal and chemical insulating properties.
- Low weight

The plastics are basically classified as:

(1) Polyethylene terephthalate (PET or PETE)
(2) High density polyethylene(HDPE)
(3) Polyvinyl chloride(PVC)
(4) Low density polyethylene(LDPE)
(5) Polypropylene (PP)
(6) Polystyrene (PS)

1.2 History

The expansion of artificial plastics are polymers began around 1869, when John Wesley Hyatt developed a cellulose derivatives [1]. His creation was later patented under the name "celluloid''. Commercially, being used in production of products canning to men's collars.

The first man-made plastic was a bio-plastic. It was made from cellulose nitrate. It was made in year 1862[1]. But this plastic was unable to prove himself as a good polymer.

1.3 Challenges In Field Of Bioplastics

1. Misconception: Even though bio degradable plastics are anticipated to be good for the environment, they can damage the nature in certain ways. Liberation Greenhouse gases like methane and carbon-dioxide, while they are degrading, is huge at landfill sites.
2. Environmental impact: Starch based bio plastics are manufactured generally from plants like corn, potatoes and so on. This sets huge pressure on the agricultural crops as they have to gratify the needs of the ever growing populace. To craft out bio-plastics, crops have to be grown and this could lead to deforestation[3].
3. Cost: Bioplastics are a novel technology and entail still more research and development to get

ascertained. Bio plastics are not thus, equivalent to conventional plastics, with respect to cost issues[3].

1.4 Advantages Of Bioplastics

1. Eco friendly: Bio-plastics is eco friendly because it is made from bio-degradable biomass like treesand vegetables etc.
2. Require less time to degrade: As bioplastics are made from biodegradable biomass, therefore it takes very less time if we established required condition to it.
3. Toxicity: As we are making bioplastic from biodegradable biomass, then it will not liberate any harmful chemical during degradation. This is pollution free process.
4. Lower energy consumption: we manufactured bioplastic with very low energy consumption.

2. METHODS AND MATERIALS:

Raw material

- Corn-starch

It is the main raw material which help bioplastic to become bio-degradable.

- Glycerine as a plasticizer

It is a small molecule such as polyol like sorbitol, glycerol etc. that intersperse and intercolate among & between polymer chains. It increases the flexibility and permeability [2].

- Distilled water

Water is used as a solvent to get the biopolymer (starch) into solution. When the solution is heated, the water helps the starch molecules to become disrupted and disordered (denatured). When dried, the disordered polymer chains become entangled and a neat film is formed. The process is called film-casting.

- Vinegar

Starch dissolves better if a small amount of ions (electrically charged particles) are present in the mixture; the polymer molecules become disordered more easily, and the resulting cast films are somewhat improved. These added ions interact with both the starch and the small amounts of other polymers (lipoproteins) that are present in commercial starch. This is why adding a little bit of vinegar is recommended specifically when making home-made bioplastic films from starch.

3. EXPERIMENTAL WORK

A. From corn starch

Firstly, We have added 10.88gm of corn-starch in beakers. Then added 30ml of water to it. Then we added glycerine 5, 10, 15,20ml in sample 1, 2, 3&4 resp. after this 5ml of vinegar was added to each sample. Then we stirred it and heat it till sticky precipitate is formed. After heating we spread the mixture on flat surface. And let the product dry.

B. From MSW

First of all ,we found the MSW just like the waste of vegetables. Then we dried MSW in sunlight for two days. Then we powdered MSW stuff in the mixer. Further we observe tiny particles in the MSW mixture so make it fine in sieve shaker .Finally, we have the fine powdered form of MSW stuff. We added 8gm of cornstarch and 3gm of MSW in beaker. then added 10ml of vinegar , 10ml of glycerine & and 30ml of water to the beaker. After this we heated the mixture and stirred continuously. After sometime, we observed gelations stuff of bioplastic. Then spread the thick layer of hot bioplastic in mould.And kept it as it is till it get in completely dry form.

Table-1: Analysis of Bioplastic From MSW

Sr. No	Weight In (Gm)	Weight (N)	Area (M^2)	Thickness (Mm)
1	16.9	0.1657	$5.676*10^{-3}$	4

4. RESULT AND DISCUSSION

a. Effect Of Plastisizer

Table: 2-Effect Of Plasticizer

Sample No.	Glycerine in ml	Thickness (mm)	Weight of film paste (gm)	Weight of film (gm)	Residence time (sec)
1	5	2	33.9	9.43	540
2	10	3	37.4	15.39	580
3	15	3	51.7	15.67	1200
4	20	4	51.3	21.772	1320

For further change in composition of raw materials (cornstarch,vinegar,H2O) we get the satisfactory result for 5 and 10 ml of glycerine composition.Glycerine composition of 15ml and 20 ml of bioplastic film were very moist and it proved difficult to dry them, so we rejected it.Glycerine of 5ml composition were mostly perforated films so that's why we rejected it and we decide to go further with 10 ml of glycerine as a plasticizer.

b. Effect Of pH

Table: 3-Effect Of pH

Sr No.	Name Of Sample	Glycerine (In Ml)	Ph
1	BP-1	5	ACIDIC
2	BP-2	10	ACIDIC
3	BP-3	15	ACIDIC
4	BP-4	20	ACIDIC

As shown in the above table, we observe the sample of bioplastic to be acidic in nature.In preparation of bioplastic, as glycerine act as a plasticizer, hence it does not make any major change to the bioplastic mixture.

c. Conversion Of Weight Into Forces

Force (N)=Weight in grams$*10^{-3}*9.81$

Table: 4-Conversion of Weight Into Forces

Sr No.	Name Of Sample	Weight (Grams)	Force (N)
1	BP-1	9.43	0.0925
2	BP-2	15.39	0.1509
3	BP-3	15.67	0.153
4	BP-4	21.772	0.2135

From above table we observed that as we increase the amount of glycerine the force increases.(as the weight of film increase due to amount of plasticizer.)

d. Analysis Of Tensile Strength

Tensile Strength=Weight (N)/Cross-Sectional Area(m^2)

Table: 5-Analysis Of Tensile Strength

Sr No.	Cross-Sectional Area(M^2)	Weight (N)	Tensile Strength(Mpa)
1	$68.88*10^{-4}$	0.0925	$1.3429*10^{-5}$
2	$2.8274*10^{-3}$	0.1509	$5.443*10^{-3}$
3	$2.3758*10^{-3}$	0.153	$6.5956*10^{-3}$
4	$3.1172*10^{-3}$	0.2135	$6.9844*10^{-3}$

As we observed that the increase in amount of glycerine leads to more tensile strength because it increases the absorption intensity of OH group on bioplastic . This is because of the glycerine having functional group OH . But a plasticizer glycerine molecule will slip between cornstarch-vinegar chain and can weaken interaction between that polymer. Thus soften the polymer matrix

e. Percentage Conversion Into Bioplastic

% Conversion=(weight of film after baking/weight of final paste put for baking)*100

Table: 6-Percentage Conversion Into Bioplastic

Sr No.	Name Of Sample	Weight Of Final Paste(Gm)	Weight Of Film (Gm)	Conversion%
1	BP-1	33.9	9.43	27.81%
2	BP-2	37.4	15.39	41.15%
3	BP-3	51.7	15.67	30.30%
4	BP-4	55.3	21.772	39.37%

As we increased the amount of glycerine by keeping all the raw material as it is, we found that conversion also increased.(except BP-2 because the film formed by the sample BP-2 wasn't need more time to make sufficient film, so we cannot heat that paste for long time and most of water remains as it is in the film. So this leads to more conversion than any other sample).

f. Comparison Between Bioplastic From Cornstarch & MSW

Table: 7-Comparison Between Bioplastic From Cornstarch & MSW

Sr No	Name Of Sample	Tearing Strength	Tensile Strength
1	BP-1	2240	$1.3429*10^{-5}$
2	MSW	1152	29.19
3	BP-3	320	$6.5956*10^{-3}$

From above table we have observed that the tearing strength of bio-plastic from cornstarch is more as compare to other bio-plastics.

CONCLUSION

The environmental pollution arising due to plastic can be overcome by using Bioplastic. From mentioned observations and result, we conclude that if we increase the quantity of glycerine (plasticizer) the tearing strength of bioplastic is decreased. i.e For sample BP-1(5ml) tearing strength is found maximum and for sample BP-3(15ml) tearing strength is minimum(by Elmendorf tearing test).As per theoretical calculations %conversion of BP-2(41.15%) is found maximum as compare to other samples. As per the theoretical calculations, the tensile strength of sample BP-4 is found greater (i.e. $6.9844*10^{-3}$Mpa) as compare to other sample made from corn starch.

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