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PREPARATION OF BIOPLASTIC FROM AGRO WASTE

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ABSTRACT

This article is based on the studies conducted by students of age 15 for a national level project on preparation of bioplastics from agro waste . Students from a school situated in rural area observed that the agro waste can be recycled, converted into bioplastics as they are environmentally friendly material and can create useful products. The project raw materials is agro waste namely coconut coir and groundnut shell available around ponneri locality , suburbs of Chennai , Tamil Nādu . The project is an attempt by students to prepare Groundnut shell-based polymer-Coconut coir-based polymer , a bioplastic that is environmental friendly material .

Key words : Bio plastics, Biodegradeable,polymer , agro waste , coconut coir, groundnut shell , ponneri

INTRODUCTION:

The increased use of conventional plastic can have adverse effects on the environment. One solution is the use of Biodegradable Bioplastics to reduce the number of environmental hazards of plastics as biodegradable plastic can be decomposed with the help of microorganisms. Bioplastics are nontoxic, recyclable & environment friendly .Bioplastic manufacturing uses renewable biomass sources such as plant-based feedstock's including corn, rice, palm fiber, potatoes, wood cellulose and other plants while traditional manufacturing of conventional plastic products utilizes non-renewable petroleum and natural gas resources.

HYPOTHESIS: Bioplastics can be made from Agrowastes (Groundnut shell and Coconut coir)which are Biodegradable.

OBJECTIVES: To convert the agrowaste coconut coir and Peanut shell that contain Lignin and cellulose into a biodegradable bioplastic with student friendly approach.

SUPPLEMENTARY DATA

SOURCES OF BIOPLASTIC FROM PLANT BASED MATERIAL:

Biodegradation is the property of a material that can be completely converted into water, Carbon dioxide and biomass through theaction of microorganisms such as fungi and bacteria. The byproducts of agricultural produce like husk, cobs, fiber, groundnuts, coconut coir are mostly important rich source of lignocellulose materials . Agricultural waste or agrowaste materials obtained after various agricultural operations are segregated to convert them into useful products by:

- Classifying the agro waste materials to separate fibre materials from non-fibre materials.
- Selecting the classified fibre materials according to a desire property.
- Forming agro waste composite by integrating selected fiber/husk with a plastic material

GROUNDNUT SHELL:

Groundnut is a nutritious leguminous crop, grown mainly for seed and oil worldwide. Groundnut shells are the leftover product obtained after the removal of groundnut seed from its pod. It contains various bioactive and functional components which are beneficial for mankind. Groundnut shells are composed of cellulose, hemicellulose, and lignin. Groundnut shells are used as a natural fertilizer for the cultivation of vegetable plants to increase their yield and to reduce the environmental pollution. Every year million tons of its quantity is left inenvironment. This waste can be converted to a valuable product to achievezero waste production. It consists of cellulose, hemicellulose, and lignin.

COCONUT COIR:

Coconut coir, also known as coco coir, is popular with a wide range of consumer. Coco coir is an excellent addition to the garden and can improve the texture of clayor sandy soil which will enable plants to grow sturdy roots. It will also allow plantsto access added nutrients during the feeding and watering process. They are biodegradable and able to break down into the nature after they become as wastes. Thus, we will reduce the amount of pollution caused by non-biodegradable polymersto the environment and we are also maximizing the use of renewable sources. Coir fiber has a high lignin content which makes it resistant, strong, and highly durable. Itcontains lignin, cellulose, hemicellulose, and water.

PARAMETERS

Based on the information collected, three samples were prepared , observed, and analyzed in detail.

1.Groundnut shell-based Bioplastic
2.Coir based Bioplastics
3.Combination of both Groundnut and coconut coir in a specific ratio

METHODS

Raw materials used :

*Groundnut Shell
* Coconut coir
*Starch
*Vinegar
*Glycerin
*Water

SAMPLE PREPARATION

•Measure 60ml of distilled water and place the water in a beaker.
•Add 10gm of corn starch and add the sample 1/2/3
2.5gm of raw material (SAMPLE 1 GROUNDNUT)
2.5gm of raw material (SAMPLE 2 COCONUT COIR) 1.25gm coconut coir
1.25gm Groundnut shell powder(SAMPLE 3 COMBINATION)
•Add 5ml of glycerin and 10ml of vinegar in the beaker. stir continuously over medium flame.
•After heating the sample , spread the mixture into the Aluminium foil and to the pan. Lift the sample after its dried and send for Lab testing

Sample 1:GROUNDNUT SHELL BASED POLYMER:

60 ml of distilled water is measured using 100 ml of measuring cylinder and pouredinto the pan. Secondly, 10 g of corn starch and 2.5 g of groundnut shell powder is put into the pan and started stirring. Subsequently, 5 ml of glycerin and 10 ml of vinegar is poured into the pan. The mixture is stirred continuously in a medium fame. After 5 minutes, a milky white liquid becomes transparent. Turned off the stove andspread the mixture in the Aluminium foil and in mold.

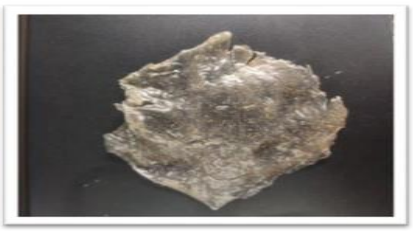
Sample 2:COCONUT COIR BASED POLYMER:

60 ml of distilled water is measured using 100 ml of measuring cylinder and pouredinto the pan. Secondly, 10 g of corn starch and 2.5 g of coconut coir powder is put into the pan and started stirring. Subsequently, 5 ml of glycerin and 10 ml of vinegaris poured into the pan. The mixture is stirred continuously in a medium fame. After 5 minutes, a milky white liquid becomes transparent. Turned off the stove and spreadthe mixture in the Aluminium foil and in mold.

Sample 3:COMBINATION OF GROUNDNUT SHELL AND COCONUT COIR BASED POLYMER

60 ml of distilled water is measured using 100 ml of measuring cylinder and pouredinto the pan. Secondly, 10 g of corn starch,1.25 g of groundnut shell powder and
1.25 g of coconut coir is put into the pan and started stirring. Subsequently, 5 ml ofglycerin and 10 ml of vinegar is poured into the pan. The mixture is stirred continuously in a medium fame. After 5 minutes, a milky white liquid becomes transparent. Turned off the stove and spread the mixture in the Aluminium foil and in mold.

Groundnut shell based polymer



Coconut coir based polymer

COMBINATION OF GROUNDNUT AND COIR

RESULTS

LAB TEST CONDUCTED

1.Soil degradation test
2. Water solubility test
3. Tensile strength test
4. Fourier transform infra-red spectroscopy

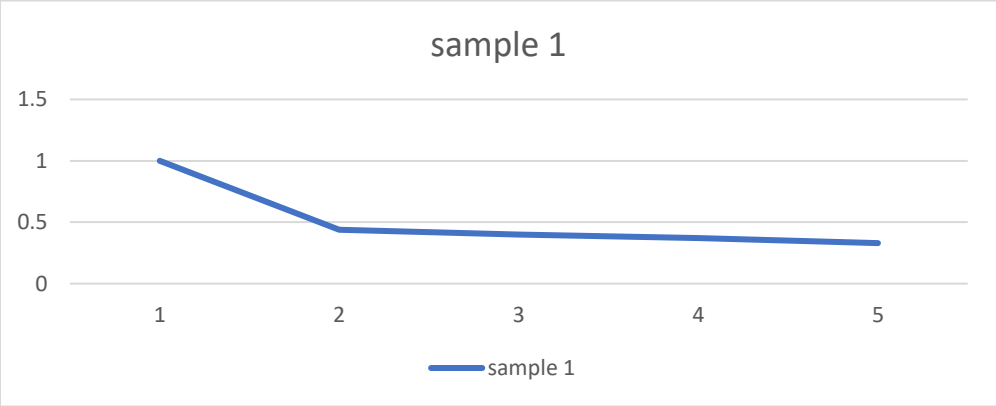
TEST 1:SOIL DEGRADATION TEST :Initial weight of the sample is measured, and the sample is buried into the soil for 24 hours. After 24 hours, the sample was taken out , washed and allow it to dry at room temperature. We followed the same procedure for 4 days to absorb the soil degradation level of the sample and results tabulated

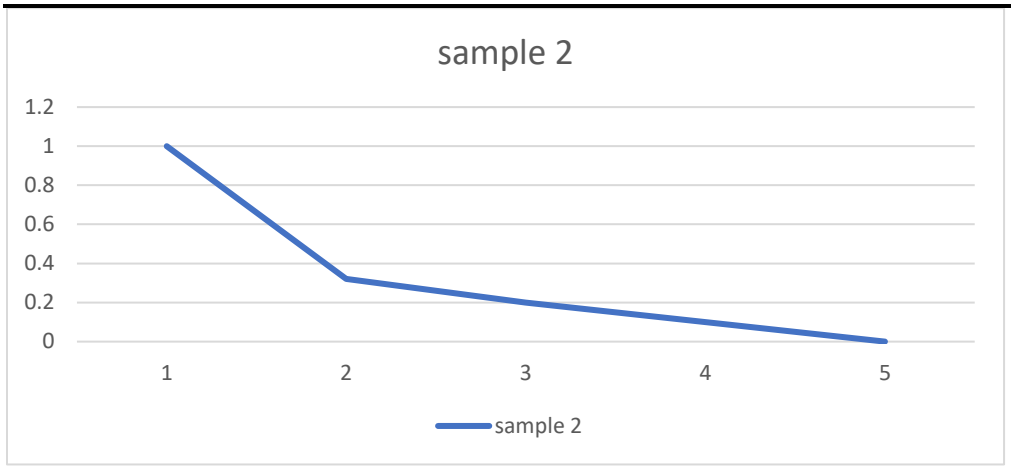
Sample – 1 : groundnut shell

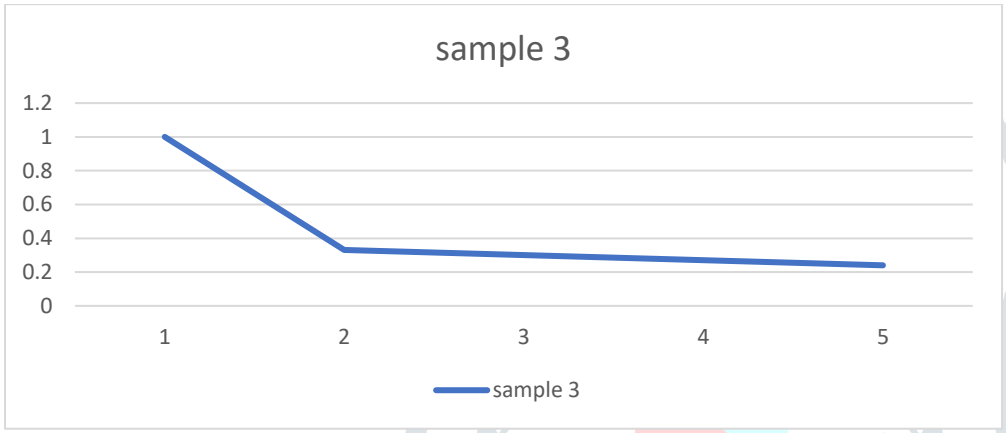
Sample – 2 : coconut coir

Sample – 3: combination of groundnut and coir

Days	Weight of the sample (g)		
	Sample - 1	Sample - 2	Sample - 3
Day 0 (Initial weight)	1	1	1
Day 1	0.80	0.30	0.45
Day 2	0.69	0.27	0.40
Day 3	0.67	0.22	0.38
Day 4	0.64	0.18	0.35

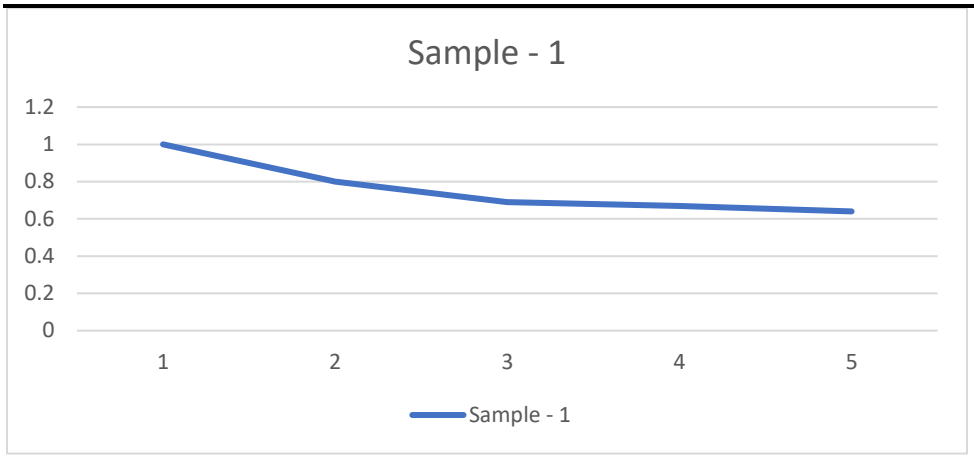


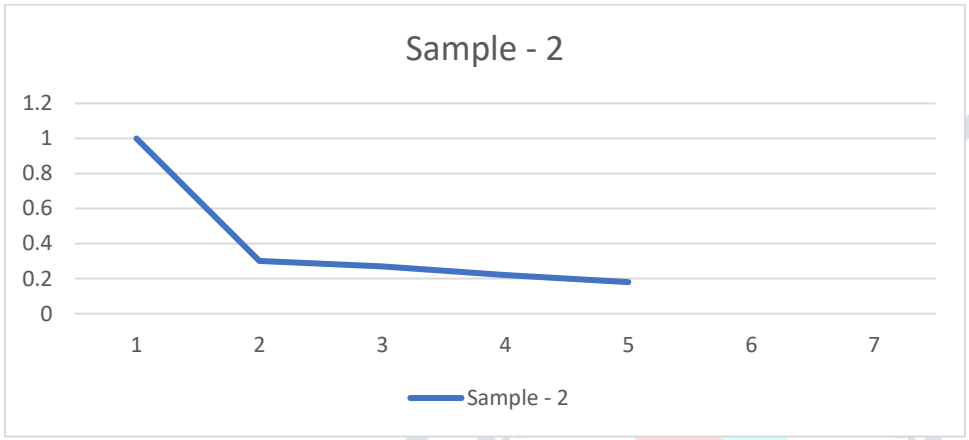


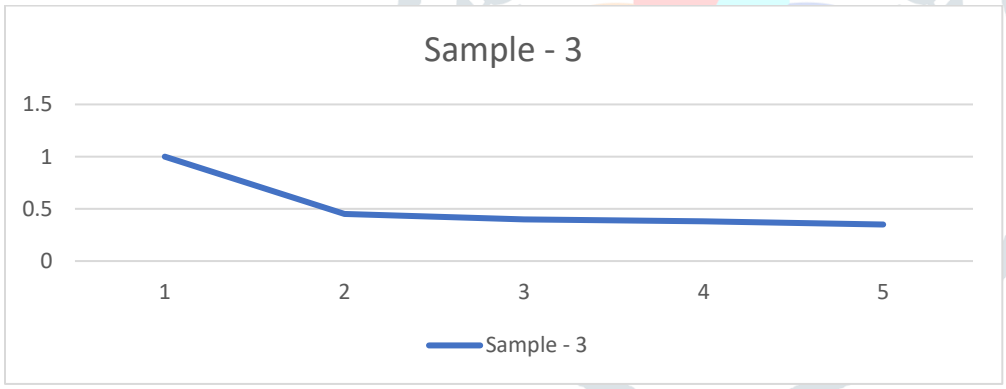


TEST 2:WATER SOLUBILITY TEST :Initial weight of the sample is measured, and the sample is placed in the water for 24 hours. After 24 hours, the sample was taken and allow it to dry at room temperature. We followed the same procedure for 4 days to observe the water solubility property of the samples.

	Weight of the sample (g)		
Days	Sample - 1	Sample - 2	Sample - 3
Day 0 (Initial weight)	1	1	1
Day 1	0.8	0.3	0.45
Day 2	0.69	0.27	0.4
Day 3	0.67	0.22	0.38
Day 4	0.64	0.18	0.35



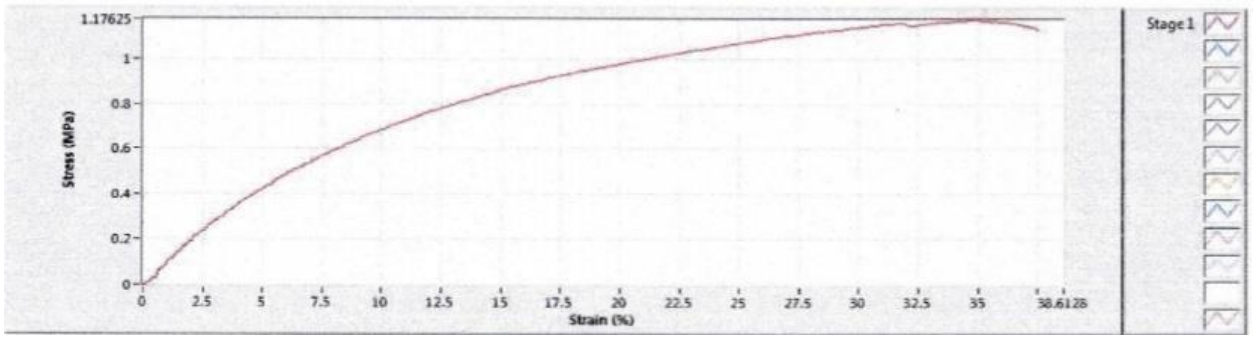




TEST 3: TENSILE STRENGTH : The samples 1,2,3 were subjected to tests to determine stretchability and rigidity

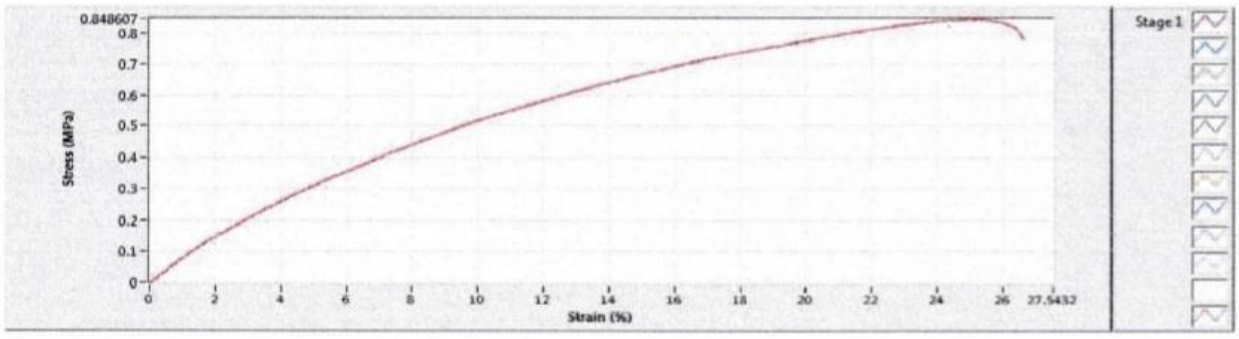
Sample 1 :Coconut coir polymer

TRAIL - 1



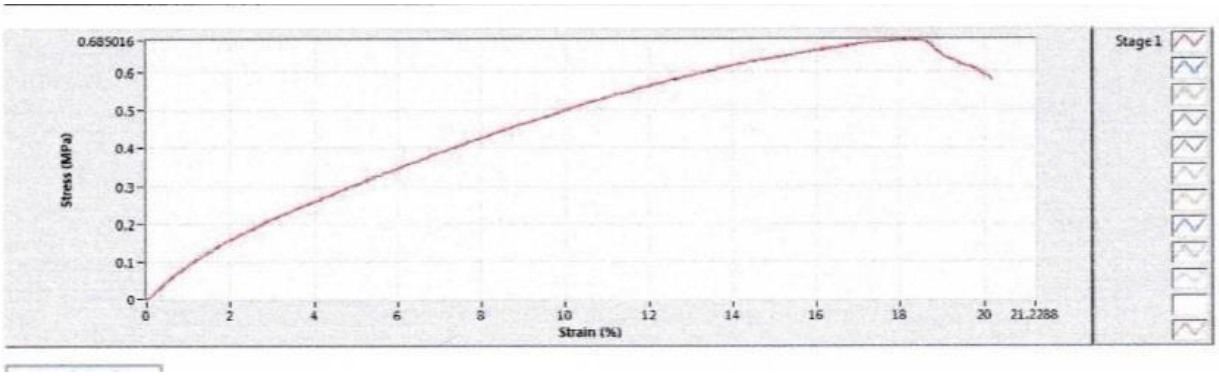
PEAK LOAD: 19.776 N
THICKNESS: 0.6725 mm
ELONGATION @ BREAK: 37.620 %
TENSILE STRENGTH: 1.127 MPa

TRAIL 2:



PEAK LOAD : 21.777 N
THICKNESS: 1.0265 mm
ELONGATION @ BREAK : 26.639 %
TENSILE STRENGTH: 0.780 MPa

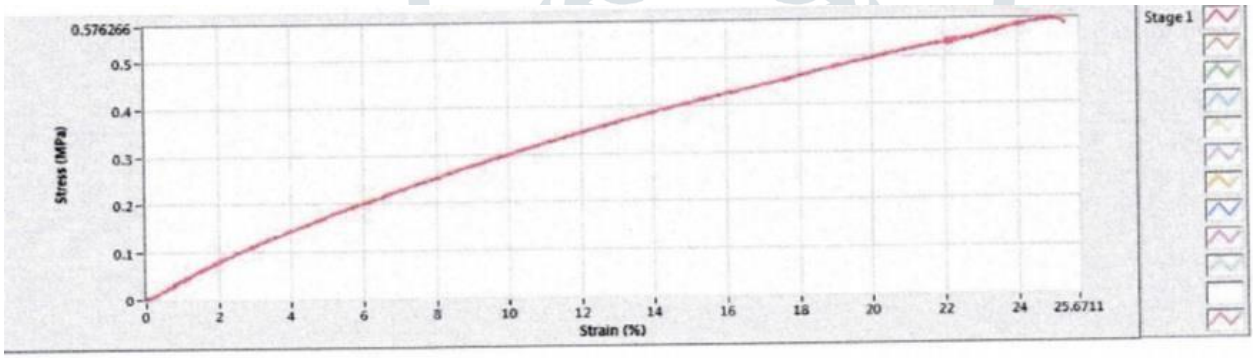
TRAIL 3 :



PEAK LOAD : 13.675 N
THICKNESS: 0.7985 mm
ELONGATION @ BREAK : 20.201 %
TENSILE STRENGTH: 0.580 MPa

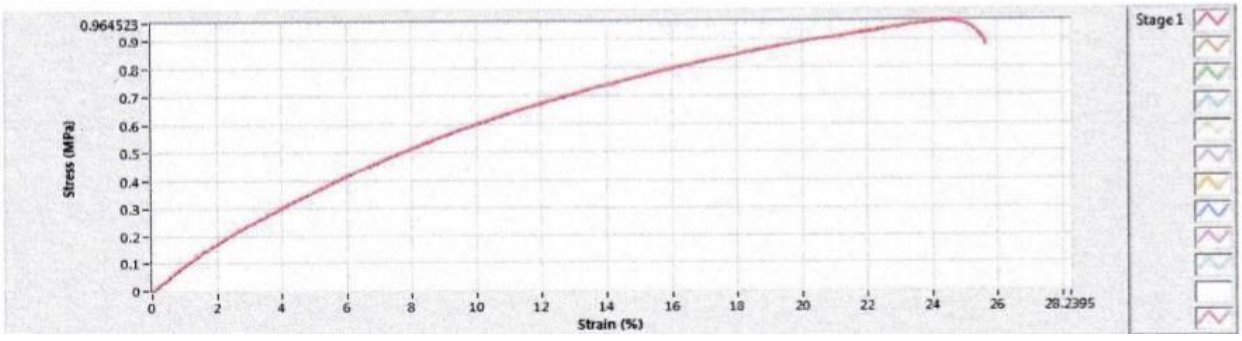
Sample 2: GROUNDNUT SHELL BASED POLYMER:

TRAIL I:



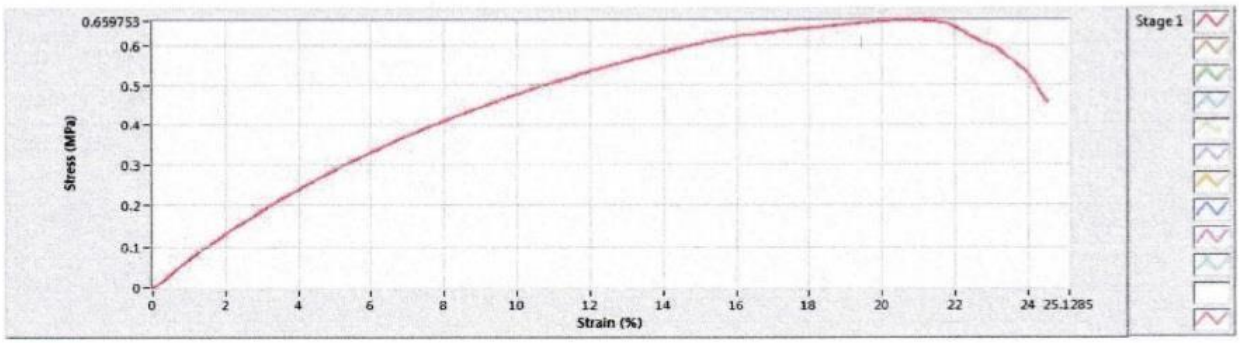
PEAK LOAD : 6.289 N
THICKNESS: 0.4365 mm
ELONGATION @ BREAK : 25.342 %
TENSILE STRENGTH: 0.563 MPa

TRAIL 2:



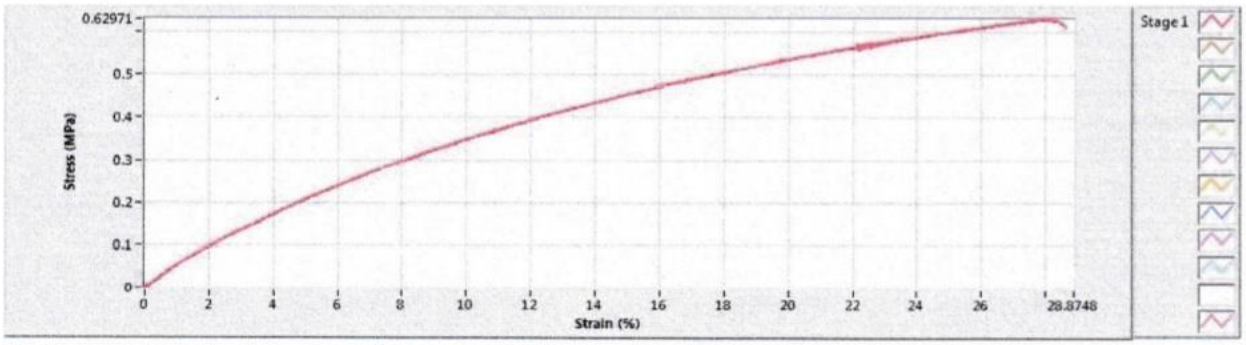
PEAK LOAD : 20.530 N
THICKNESS: 0.8514 mm
ELONGATION @ BREAK : 25.551 %
TENSILE STRENGTH: 0.877 MPa

TRAIL 3:



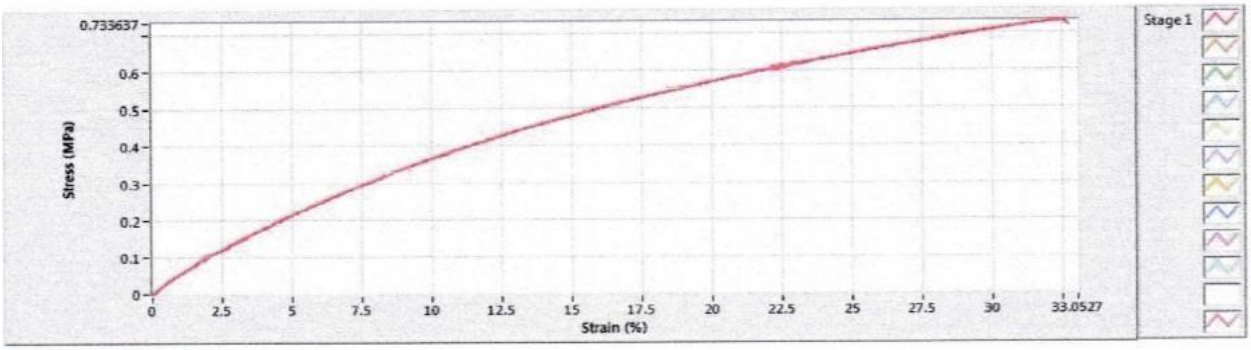
PEAK LOAD : 18.382 N
THICKNESS: 1.1145 mm
ELONGATION @ BREAK : 24.550 %
TENSILE STRENGTH: 0.455 MPa

Sample 3: COMBINATION OF COCONUT COIR AND GROUNDNUT SHELL:
TRAIL-1:



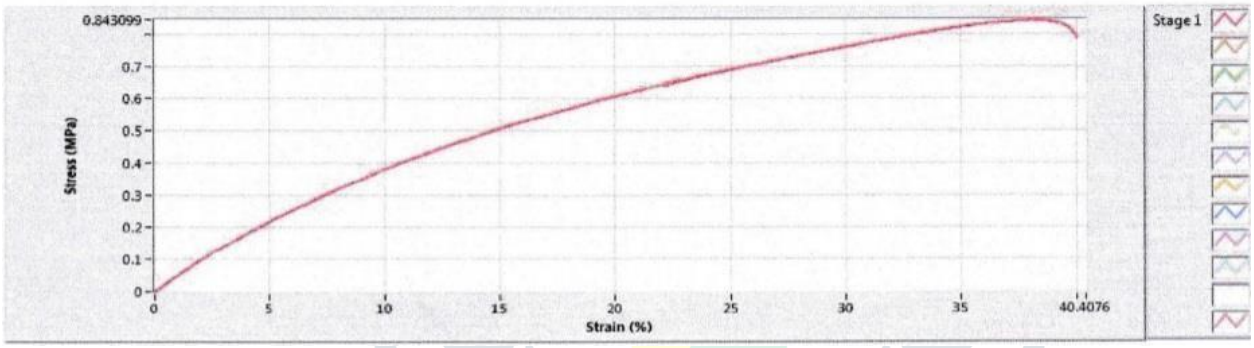
PEAK LOAD : 12.385 N
THICKNESS: 0.5876 mm
ELONGATION @ BREAK : 40.047 %
TENSILE STRENGTH: 0.785

TRAIL 2:



PEAK LOAD : 7.639 N
THICKNESS: 0.4165 mm
ELONGATION @ BREAK : 32.737 %
TENSILE STRENGTH: 0.721 MPa

TRAIL 3 :

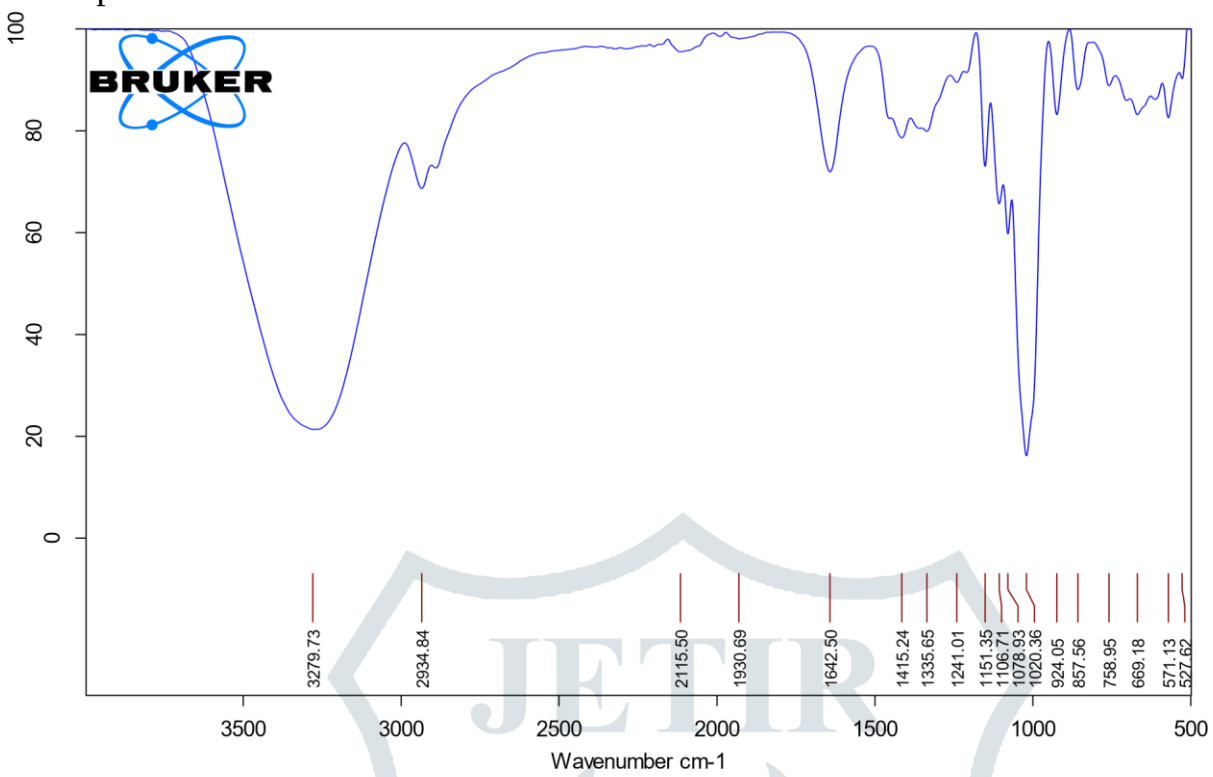


PEAK LOAD : 12.385 N
THICKNESS: 0.5876 mm
ELONGATION @ BREAK : 40.047 %
TENSILE STRENGTH: 0.785 MPa

RESULTS OF TEST 4 FT – IR SPECTROSCOPY:

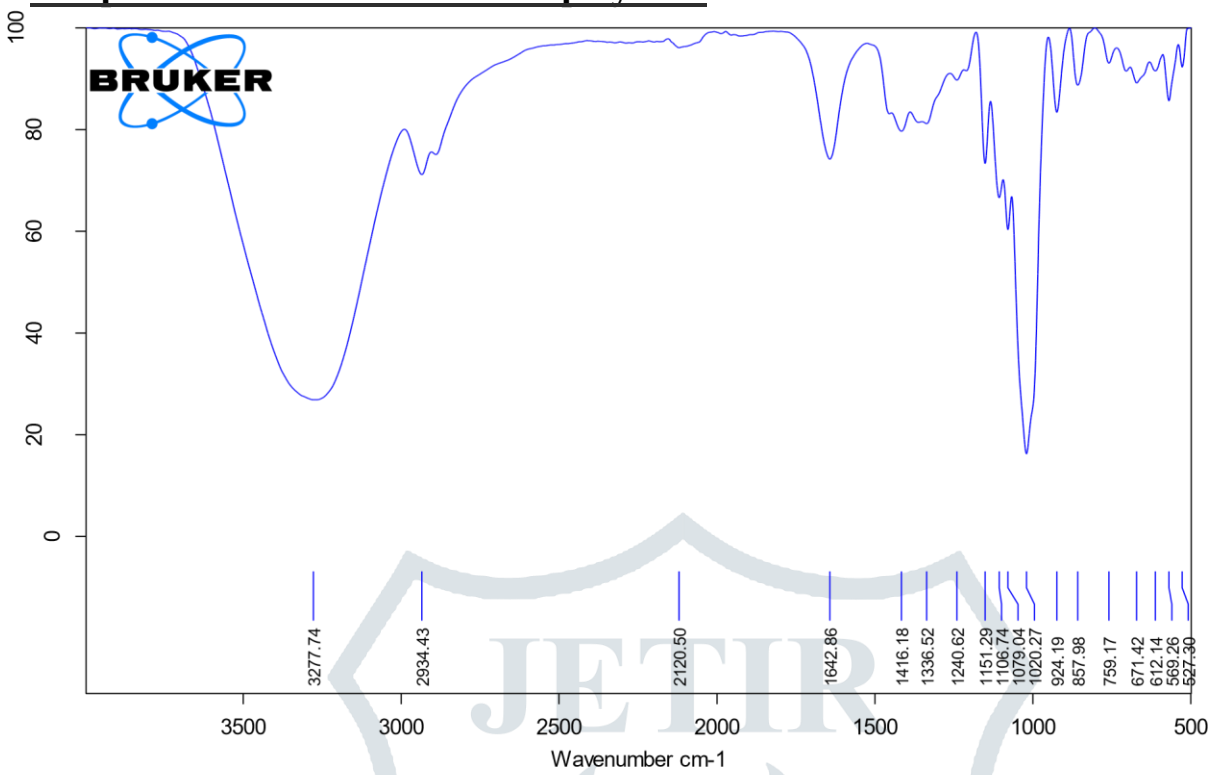
FT-IR stands for Fourier Transform Infrared Spectrometer – the preferred method of infrared spectroscopy. Infrared spectrum is an important record which gives sufficient information about the functional groups of a compound.

Sample 1: Coconut COIR BASED POLYMER:



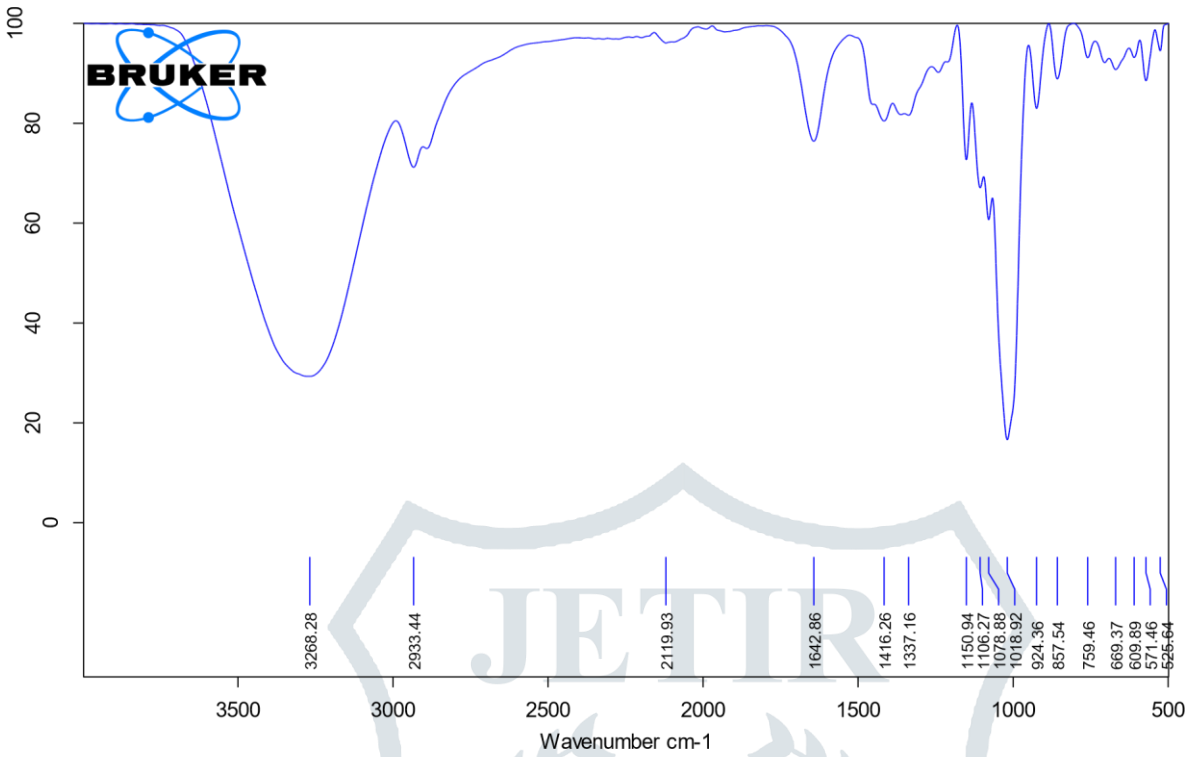
WAVENUMBER	FUNCTIONAL GROUP	VIBRATIONAL MODE	SHAPE&INTENSITY
3279.73	INTRAMOLECULAR HYDROGEN BONDED	O-H STRETCHING	STRONG AND BROAD
2934.84	ALKANE	C-H STRETCHING	MEDIUM
1930.69	AROMATIC COMPOUND	C-H COMPOUND	WEAK
1642.50	ALKENE	C=C STRETCHING	MEDIUM
1020.36	PRIMARY ALCOHOL	C-O STRETCHING	MEDIUM
1415.24	ALCOHOL	O-H BENDING	MEDIUM

Sample 2:Groundnut shell based polymer:



WAVENUMBER	FUNCTIONAL GROUP	VIBRATIONAL MODE	SHAPE&INTENSITY
3277.74	ALCOHOL	O-H STRETCHING	MEDIUM
2934.43			
1240.62	AMINE	C-O STRETCHING	WEAK
1020.27	ETHER	C-O STRETCHING	STRONG
671.42	ALKENE	C=C BENDING	WEAK

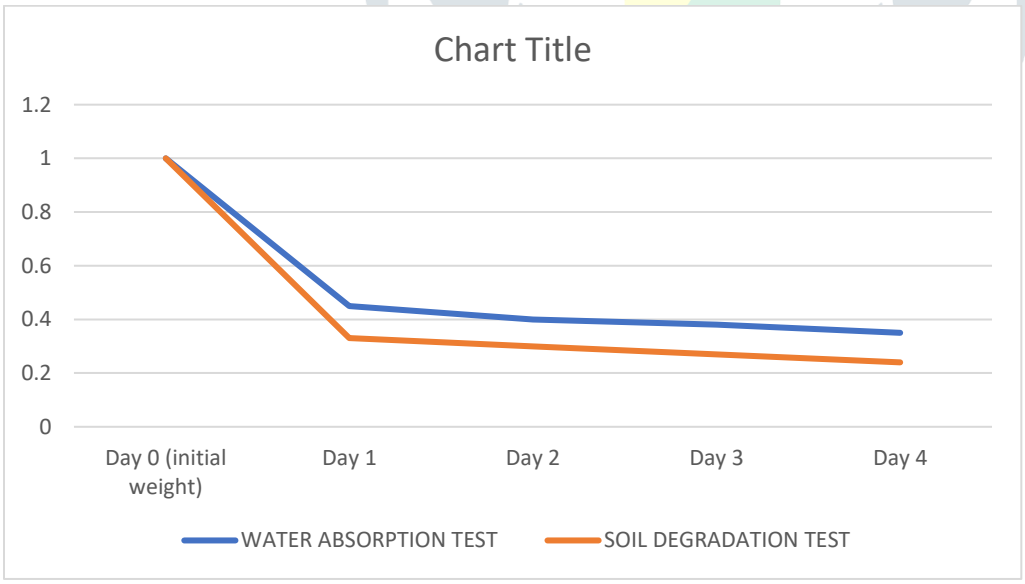
Sample 3:COMBINATION OF COIR AND GROUNDNUT SHELL BASED POLYMER:



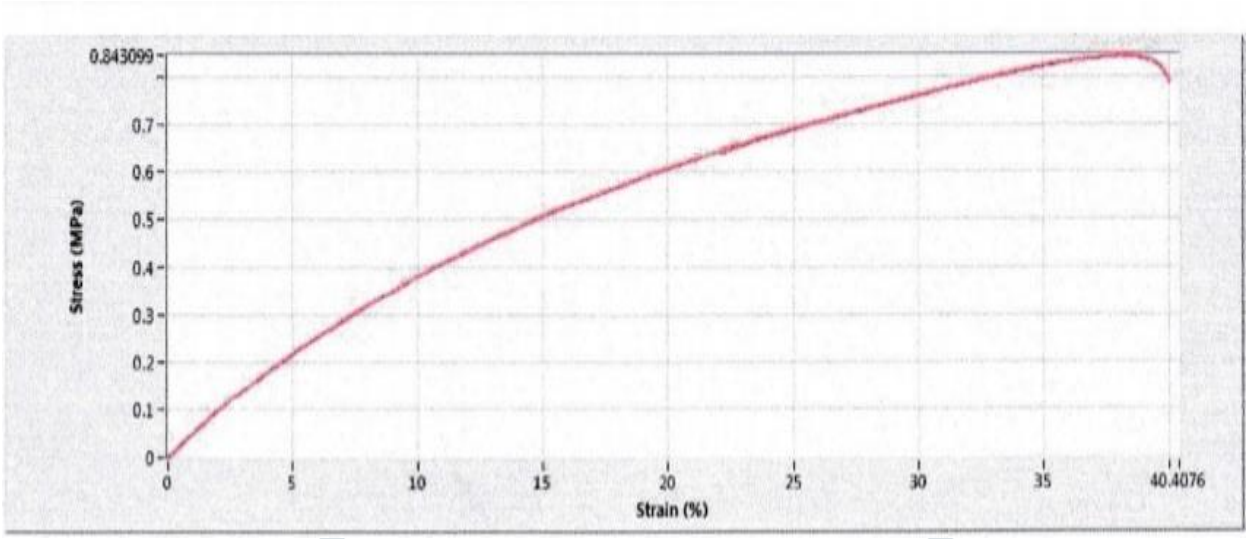
WAVENUMBER	FUNCTIONAL GROUP	VIBRATIONAL MODE	SHAPE&INTENSITY
3268.28	ALIPHATIC PRIMARY AMINE	O-H STRETCHING	BROAD & MEDIUM
2933.44	ALKANE	C-H STRETCHING	MEDIUM
1416.26	ALKANE	C-H BENDING	MEDIUM
1106.27	AMINE	C-N STRETCHING	MEDIUM
1078.88	PRIMARY ALCOHOL	C-O STRETCHING	STRONG

OBSERVATION SAMPLE 3. Combination of coconut coir and groundnut shell

	WATER ABSORPTION TEST	SOIL DEGRADATION TEST
Day 0 (initial weight)	1	1
Day 1	0.45	0.33
Day 2	0.40	0.30
Day 3	0.38	0.27
Day 4	0.35	0.24



TENSILE STRENGTH OF THE SAMPLE 3:



TRAIL 3	PEAK LOAD (N)	THICKNESS (mm)	ELONGATION AT BREAK %	TENSILE STRENGTH
	12.385 N	0.5876	40.047	0.785

DISCUSSION

During the sample preparation we observed that,

- The sample was thick milky white liquid
- Thickness of the prepared sample reduced into a thin film, once dried.
- The coconut coir and peanut shell samples were sticky after partial dryness When it was removed from the Aluminium foil, but the stickiness reduced after the samples were kept in microwave oven for 20 min at 80 degrees Celsius.
- The combination of Peanut shell and coconut coir was easy to peel off the aluminium foil and was not sticky after drying.
- The texture of the combination sample was shiny and transparent
- In the water solubility test and the soil degradation test, we observed that the weight of the sample is reduced day by day.
- We observed that the combination of coconut coir and peanut shell has good flexibility and durability
- We identified the functional groups of a compound present in the sample through FTIR test

During the first level of testing , we found that the combination of peanut shell and coconut coir sample is better while comparing the other two samples-based observations and lab results .We planned to make a product that is useful to common people , Biodegradable waste garbage bin as the Bioplastic

sample is compostable, stretchable, and rigid . Sample 3 a combination sample has good stretchability and rigidity, we ca be used to make storage bottles, carry bags and tablet covers .We tried to make products from our samples of tablet cover and successfully presented a simple version of it during state level presentation. As they are manufactured from the source of plant, there is a risk of contamination in the enclosed medicine, it needs further study based on the type of medicine packed using bioplastics.

As an extended version of our project**,** to carry forward the project to the next level we planned to make Glucose bottle but due to the low bio stability of the sample there is a chance of risk of contamination. We were advised by experts to explore more about it. We plan to suggest that protection masks for miners to eliminate risk of contamination due to dust , may need further study. We have consulted resource persons who are bioplastics manufacturers to try out our sample in their molds to make suitable products that are environmentally friendly and useful in medical industry .

CONCLUSION:

Inference based on lab tests ,the soil degradation test and the water solubility test, our sample 3 a combination of coconut coir and groundnut shell in a specific ration is degradable in the soil and water soluble .FTIR test confirms that our sample consists of only organic compounds and environment friendly . The tensile strength of sample 1,2,3 compared, and it's concluded that sample 3,the combination of coconut coir and peanut shell has good stretchability and rigidity.

From our experiments, results prove that groundnut and coir combination can be used as a bioplastic. It can be used to make useful products as it possesses good quality elongation and easily degradable in soil and water

Qualities the sample prepared a combination of coconut coir and groundnut shell

- It has good stretchability ,rigidity and sturdy
- It possesses degradability and it is environment friendly .
- Prepared from agro waste Low cost and easily available raw materials
- Zero waste management can be used in medical field as bio polymer in making Tablet covers,Glucose bottle, etc. . .

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