

# **Experimental Validation of Agave Fibre and Banana Fibre Bio Composite Material Properties with Polypropylene**

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**ABSTRACT:** Increase of the awareness on importance of protecting the environment has urged researches around the globe to find ways to produce goods that can minimize harm to the environment; hence biocomposite material is helpful in achieving the objective. Biocomposites are going to be bright future of the world. Biocomposite materials are produced using natural fibres thus minimizing the harm to the nature. Agave and banana plant gained attention as material in production of biocomposites because of its availability in abundant, cheaper in price and its fast growing properties which make it capable to deliver a large volume of raw material in short period of time. Along with these fibres starch, resin and hardener is used as a biodegradable matrix. These fibres are selected because of its high mechanical properties and availability. In this paper the test specimens are manufactured by maintaining the ratio of starch, resin and hardener. As the polypropylene and HDP materials are used mainly in automobile industry which is non-biodegradable in nature. The main aim is to replace it by the biocomposites material manufactured from natural fibres. The biocomposites material is also very much cost effective i.e. lesser in cost. The starch as well as fibres used in composite material are easily decomposes after burying in ground hence not affecting the environment, and also reducing the cost of disposal. This paper contains the comparative results of composite materials manufactured from the agave leaf fibres and the HDP material which generally used in manufacturing automobile parts.

**KEYWORDS:** Biocomposite, Agave leaf fibre, Banana truck fibre, Decomposable.

## I. INTRODUCTION

The right way of using the natural resources is one of the factors for the social and economic development of human being from last few decades. Researches have tried to use natural resources in fibres form as reinforcing material to produce composite. The use of petroleum based product and the various plastic material has raised many problems regarding environment. Because of the environmental problems the term known as bio-composites came into its existence. These bio-composites materials are manufactured for and using one or two constituents (fibres) according to the purpose of use. Along with the fibres, starch and resin-hardener is used as matrix, these materials have partial or complete degradation and they do not require any external energy resource for their settlement disposal process. by using bio-composite materials we are able to substitute the recently used conventional petroleum based plastic. When these material disposed in soil, the microbes in the soil attacks on the component and leaving behind the porous sponge like structure. Each reaction results in the scission of molecule, slowly reducing the width of matrix until the entire matrix has been degraded. For composite materials made from renewable materials the greatest advantage, is to be gained by having natural fibres. Natural fibres have already found applications in various sectors. This is often because variability in fibre properties can lead to variability in mechanical properties. An experimental investigation of the natural fibre composite material and the high density plastic (HDP) material is done using the different mechanical tests and we come to some positive results. The details of the design and the specifications of the materials also the results are compared in the papers. B.C.Mitra [1] studied the biocomposites and after experimentation he opened up an opportunity to supplement and may eventually replace petroleum-based composite materials. Paul A Fowler, J Mark

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Hughes [2] studied the biocomposites from crop fibres and resins. They conclude that non-food crops and bio-renewable resources offer an almost unlimited supply of potential fibre and resin feedstocks as sustainable raw materials for biocomposites. this will help to ensure that the optimum combinations of natural fibres and matrices can be brought together at financially viable prices. Mr. Vignesh M, Dr. H. G. Hanumantharaju, Mr. Avinash S [3] studied mechanical properties of Vinylester based bio-composite material with starch as a filler material and concluded that bio-composites can supplement and eventually replace petroleum based composite materials in several applications. From the experiments they also concluded the satisfactory performance of Biocomposites in all aspects compared to other composites. Shailesh Kumar Singh, Prabhat Kumar Sinha and Earnest Vinay Prakash [4] studied an analysis & application of bio-composite smart materials. Form the experiment, they found that the incorporation of natural fibers such as sisal/jute with glass fiber improve the tensile and flexural strength and these composites play a vital role in the field of engineering and technology. They concluded that Hand lay-up technique is successfully employed in manufacturing composites with relative ease and accuracy. the wastage of fibre is also less. This biocomposite is easily used to fabricate light weight and reasonably good strength parts for automobile door panels, house hold applications like doors, window frames etc. J. Sahari and S.M. Sapuan [5] studied natural fibre reinforced biodegradable polymer composites. They concluded that its hydrophilic properties makes the real challenge to design the product which can be good candidate for outdoor applications. Thus, further research and improvement should be conducted so that these fully degraded composites can easily be manipulated and can give benefit to all mankind and environmental issues. Paul A Fowler, J Mark Hughes and Robert M Elias [6] studied biocomposites and concluded that material can comprising with good mechanical properties so they can easily replace the polymers in coming years. R.H. Martin, S. Giannis, S. Mirza and K. Hansen [8] studied biocomposites in challenging automotive applications. They concluded that consistency and repeatability of biocomposite materials was very good. While biocomposites tend to be more brittle and hydrophilic than hydrocarbon based resins. Begum K. and Islam M.A. [9] studied that Natural Fiber as a substitute to Synthetic Fiber in Polymer Composites. They conclude that which improve the mechanical strength of polymer composites.

Paper is organized as follows. Section II describes design specifications of the biocomposite samples. The flow diagram represents the step of the algorithm. After detection of text, how text region is filled using an Inpainting technique that is given in Section III. Section IV presents experimental results showing results of images tested. Finally, Section V presents conclusion.

## II. DESIGN SPECIFICATIONS

The standard test specimens were manufactured of sizes 100 mm x 13 mm. Details of the specimens are as follows (Resin and hardener used in the proportion of 2:1 i. e 2 unit of resin and 1 unit of hardener).

Table 1 Sample Details

Sr. No	Sample No.	Reinforcement fibre	No. Of layers
1	Bio composite No. 5	Agave Fibre	8
2	Bio composite No. 4	Banana Fibre	8
3	Bio composite No. 6	Banana Fibre	8
4	Bio composite No. 9	Agave Fibre	4
5	Bio Composite No. 14	Agave Fibre	8

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### III. EXPERIMENTAL RESULTS

The results of the test specimens were obtained from Dutech India Laboratory, Pune. The main aim of our project is to study flexural and impact strength. Application based on flexural strength using plastic materials need to be replaced with biocomposites material.

After testing we got the following Graphs,

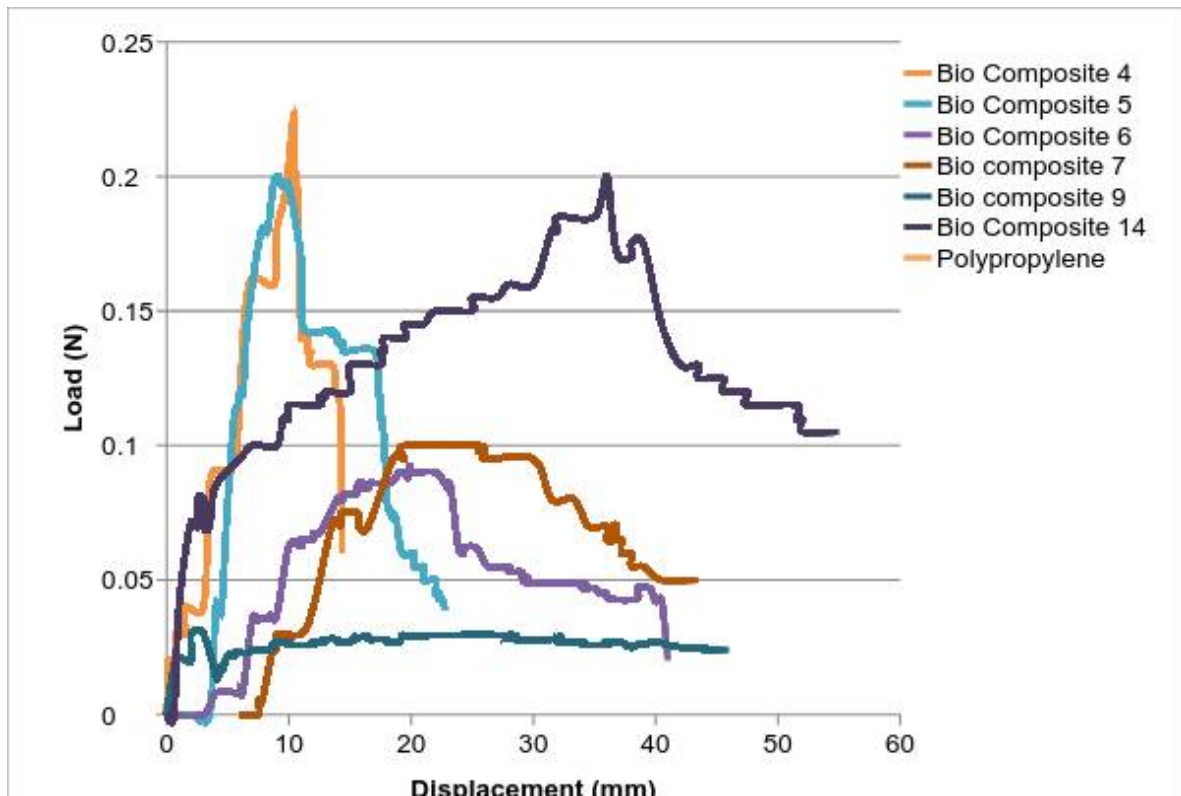


Fig. 1. Load vs Displacement graph for Bio Composite test specimen

As per the information that we got from laboratory, it was observed that as the specimens are varying with thickness so it is impossible to compare the values as well as graphs with each other. But from the experimental results it was observed that the flexural strength of the biocomposites materials are always better than the compared polypropylene material and also biodegradable in nature. The results are display in tabular form as below,

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Table No. 2 Flexural Strength of Tested Specimens

Sr.No.	Sample	Description	Width(mm)	Thickness (mm)	Flexural strength(N/mm <sup>2</sup> )
1	Biocomposite-4	Banana Fibre	12.04	11.12	55.53
2	Biocomposite-5	Agave fibres	10.30	7.88	81.95
3	Biocomposite-6	Banana Fibre	9.72	9.11	29.98
4	Biocomposite-7	Agave fibres	9.98	3.69	71.73
5	Biocomposite-9	Agave fibres	10.88	3.41	81.34
6	Biocomposite-14	Agave fibres	12.20	8.04	62.52
7	Sample- 1 (PP)	H 11 0 MA	10.53	4.4	36.63
8	Sample-2 (PP)	H 11 0 MA	10.53	4.4	31.72

#### IV. DECOMPOSE OF BIOCOMPOSITES

Decomposition is the process by which organic substances are broken down into simpler matter. The process is a part of nutrient cycle and is essential for recycling the finite matter that occupies physical space in the biosphere. Biodegradation is the disintegration of materials by bacteria, fungi, or other biological means. Although often conflated, biodegradable is distinct in meaning from compostable. While biodegradable simply means to be consumed by microorganisms, "compostable" makes the specific demand that the object break down under composting conditions. The term is often used in relation to ecology, waste management, biomedicine, and the natural environment and is now commonly associated with environmentally friendly products that are capable of decomposing back into natural elements. Organic material can be degraded aerobically with oxygen, or anaerobically, without oxygen. Bio-surfactant, an extracellular surfactant secreted by microorganisms, enhances the biodegradation process. Non-Biodegradable material waste creates more of a problem for society. When we dispose them in a garbage pile, the air, moisture, climate, or soil cannot break them down naturally to be dissolved with the surrounding land. They are not biodegradable. However natural waste and products made from nature break down easily when they are disposed as waste. Hence we are going to use biocomposite materials.

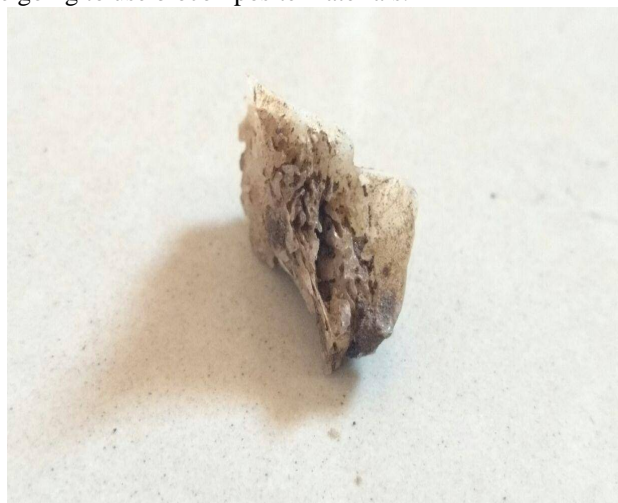


Fig. 2 Material decomposed after two months in Soil

We used starch as a matrix because it is biodegradable in nature. Selected specimen was chosen for biodegradation, we observed that only water or only soil is not enough for degrading the biocomposite material. Along with soil water also

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acts as an important factor which helps in degradation of biocomposite material. When the specimen was placed in the soil, the bacteria present in soil helps to decompose. For the proper decomposition to start at least tenure of one month is required. Only water or soil coming in contact with the biocomposite material naturally, does not help in degradation of the same. The Bio composite material starts degrading properly after two months which are placed in the soil. The material becomes porous in nature as shown in above Fig.2.

## V. CONCLUSION

From the experimental results, we studied that the flexural strength of biocomposite specimens is more than the impact strength, which is capable of sustaining external forces that are competing the existing applications in the market. As the flexural strength is more, it can be used as a biocomposite leaf spring in automobiles. For the application of higher flexural strength upto 80 N/mm<sup>2</sup>, these materials can sustain the corresponding forces. Biocomposite materials also find use in the applications such as framework, trusses, structure where flexural strength is of more importance. These biocomposite materials made of banana, agave as a fibres and starch as a matrix works good under the flexural strength.

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