# MECHANICAL PROPERTIES OF HYBIRD NATURAL FIBER COMPOSITE (BANANA, SISAL, FLAX)

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***Abstract-The main aim of this work is to fill unsaturated epoxy resin with agricultural waste, as reinforcement, to prepare polymer composites. Fibers sodium hydroxide and distilled water. The fibers and matrix are developed in different ratios around 35:65 commonly treated. The flexural behavior of the prepared composites was studied. An enhancement in the mechanical properties was achieved after chemical treatment. In addition, water absorption and % of Elongation was conducted showing that the produced fibersepoxy composite with appreciable mechanical and physical properties is a new partner and cost effective material for many advanced industrial applications in addition to their environmental friendly behavior.***

## I. INTRODUCTION

In recent years, the natural fibers have importance as potential structural material. The attractive plus point of natural fiber is in terms of industrial usage, which has made its availability more demanding. Keeping this in view the present work has been undertaken to develop a polymer matrix composite (epoxy resin) using bagasse fiber as reinforcement and to study its mechanical properties and performance. The composites are prepared with different volume fraction fibers.

The mechanical properties of several types of matrix systems are based on the chemical and structural based applications such as wind tunnels, transport vessels, support structures in space shuttles androckets. In these applications they are often under loading. The attractive features of natural fibers like jute, sisal, coir and banana have been their light weights low cost, renew ability and high modulus.

An important property of natural fibers to be used as reinforcements is their availability in quantities. For several more technical oriented applications, the fibers have to be specially modified regarding, homogeneity of the fibers properties, degree of polymerization, good adhesion between fiber and matrix.

Three different natural fibers were used to reinforce polymer composite matrix, using in each case a fiber content rangefrom 5 to 35 wt.% and remaining matrix is developed for adhesiveness. The effect of fibers on the mechanical properties of composite materials were investigated, namely the tensile, flexural and water absorption.

## II. METHODOLOGY

### *A. Natural Fiber Preparation*

First the natural fibers are washed in the distilled water. The cleaned natural fibers are dried. The dried natural fibers are again washed by chemical cleaning processes. In chemical cleaning processes the sodium hydroxide is mixed with distilled water. The dried natural fibers dipped in the diluted sodium hydroxide and again dried in sun light. The dried natural fibers are cut in the length of 15 mm by EDM machine. The cut natural fibers are used in fabricating the natural fiber composites.

### *B. Preparation of Epoxy and Hardener*

The thermoset matrix used to fabricate the fiber specimen was epoxy LY556 of density 1.15 to 1.20 g/cm$^3$, mixed with hardener HY951 of density 0.99 g/cm$^3$. The weight ratio of mixing epoxy and hardener was 10:1.

### *C. Requirements for Fabricate Natural Fiber Composites*

- Natural fiber
- Epoxy Resin
- Hardener
- Weighing Machine
- Sodium Hydroxide
- Compressive Moulding Machine

### *D. Fabrication Process*

Here Compressive Molding is used forfabricating the natural fiber composites. The base plate is fixed inside the frame for fabricating the natural fiber composites 65%of resin, hardener mixture and remaining natural fibers are used. The resin mixed with hardener is fills in the pattern. The prepared natural fibers are randomly poured in the resin hardener mixture without any gap. The roller is rolled in the mould. Again the mould is filled in pattern by next layer and fibers poured randomly. This process is simultaneously done till the height of the mould 10mm.The lid is fixed on the top of the frame for distribute the load evenly on the mould. The setup is kept inside the Moulding machine 2hours heated in 353k.

After 2hours the mould is taken away from the pattern, finally the natural fiber composite is fabricated.

### *E. Preparation of Composites*

Polymer composites reinforced with various ratio of natural fibers were prepared by composite neat Epoxy with the three treated natural fibers, those being Banana, Sisal and Flax.

Table.1 Weight ratio of Fiber and Resin

| Sl.no | Weight ratio | Banana % | Sisal % | Flax % | Matrix % |
|---|---|---|---|---|---|
| 1 | 35:65 | 10 | 5 | 20 | 65 |
| 2 | 35:65 | 10 | 10 | 15 | 65 |
| 3 | 35:65 | 10 | 15 | 10 | 65 |

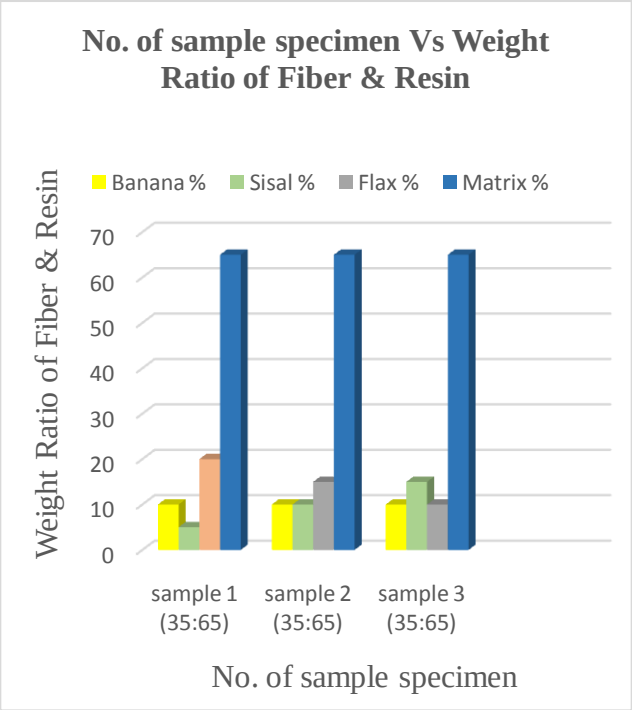


Figure.1 No. of Samples Vs Weight Ratio Fiber and resin

### *F. Material Properties*

The main objective is to determine the material properties (Flexural modulus, % of Elongation, % gain of water,) of natural FIBRE reinforced composite material by conducting the following respective tests.

- Flexural test
- Tensile test
- Water absorption Test

## III. RESULTS AND DISCUSSION

### *A. Flexural Test Result*

The flexural test measures the force requiredto bend a beam under three-point loadingsituations as per the ASTM standard dimensions D790 (125 X 13 X 3) mm. The data are often used to select elements for parts that will support loads without inflection. Flexural modulus is used as an indication of a material stiffness. The physical properties of many elements can vary depends on the natural climate condition, it is appropriate to test materials at temperatures that simulate the intended end use environment.

Table.2 Flexural Modulus of 3 samples

| Fiber & resin weight ratio | Sample A | Sample B | Sample C |
|---|---|---|---|
| 35:65 | 598.937 | 666.080 | 272.131 |
| 35:65 | 121.462 | 304.188 | 655.216 |
| 35:65 | 720.043 | 603.390 | 374.358 |
| Average Flexural Modulus (Gpa) | 480.147 | 524.552 | 433.901 |

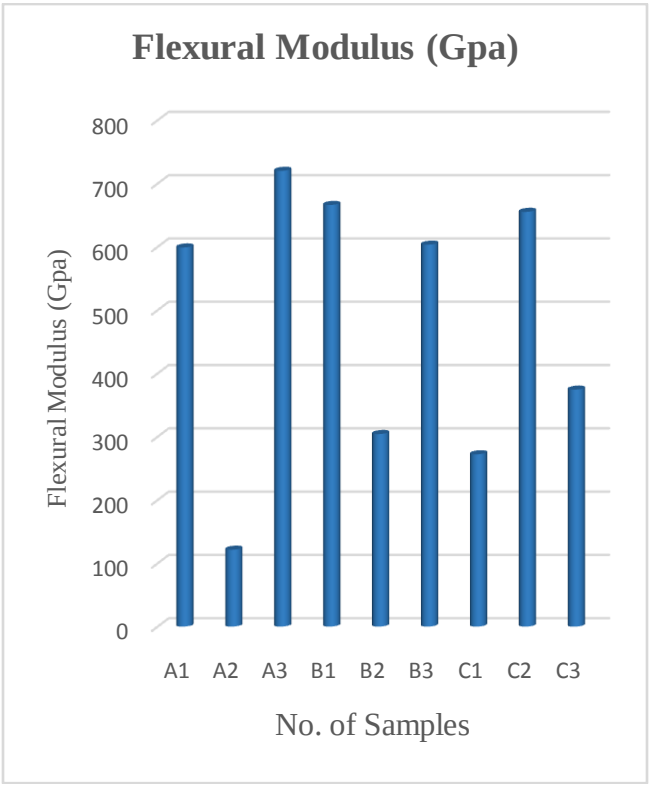


Figure.2 No. of Samples Vs Flexural Modulus (Gpa)

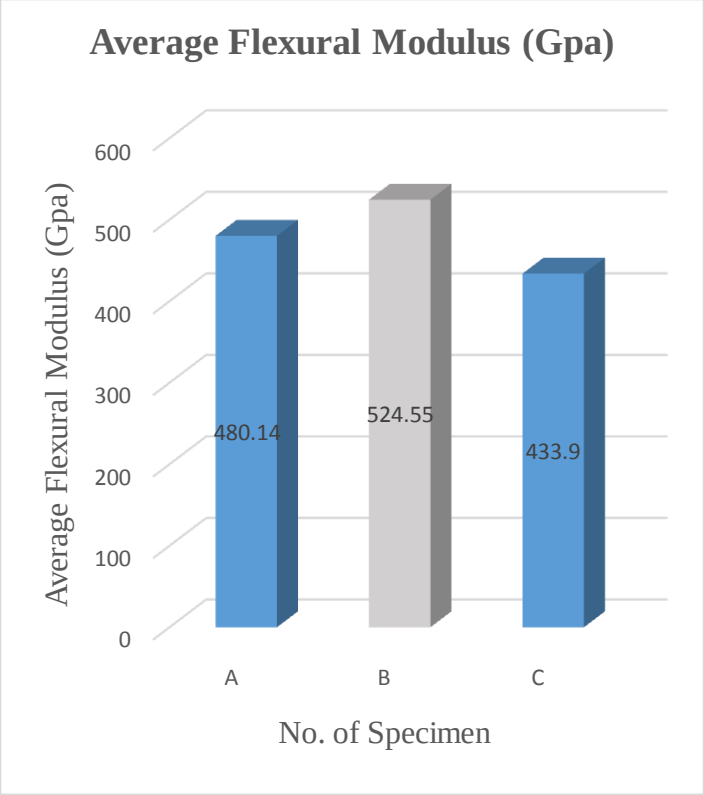


Figure.3 No. of Specimens Vs Average Flexural Modulus (Gpa)

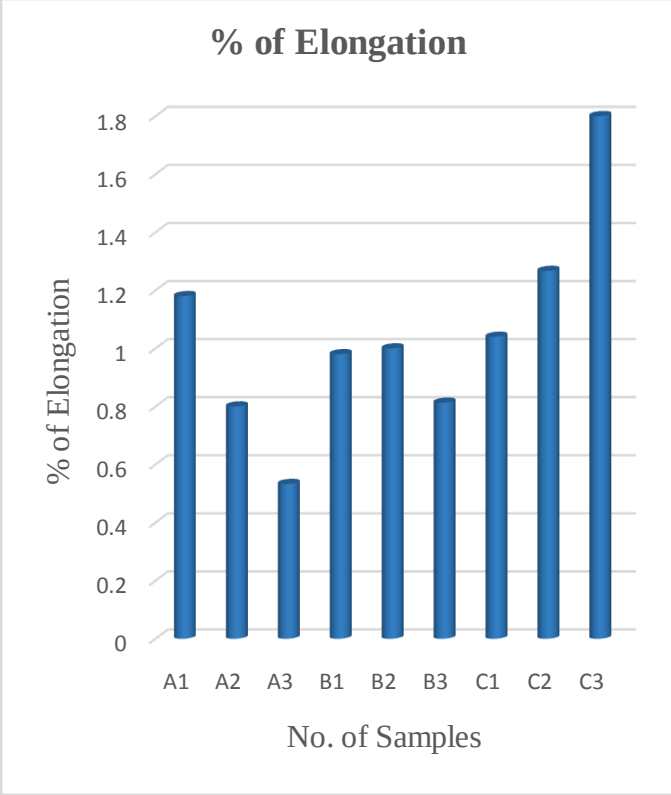


Figure.4 No. of Samples Vs % of Elongation

B. *Tensile Test Result*

As the material is being pulled, we can establish its strength together with how much it will elongate. The point of failure of the material is of significant interest and it is typically called its Ultimate Tensile Strength. The Specimens are fully ASTM D3039Standardized. The dimension is (250 X 25 X 3) mm.

Table.3 % of Elongation 3 samples

| Fiber & resin weight ratio | Sample 1 | Sample 2 | Sample 3 |
|---|---|---|---|
| 35:65 | 1.180 | 0.980 | 1.040 |
| 35:65 | 0.800 | 1.000 | 1.267 |
| 35:65 | 0.533 | 0.813 | 1.800 |
| Average % Elongation | 0.837 | 0.931 | 1.369 |

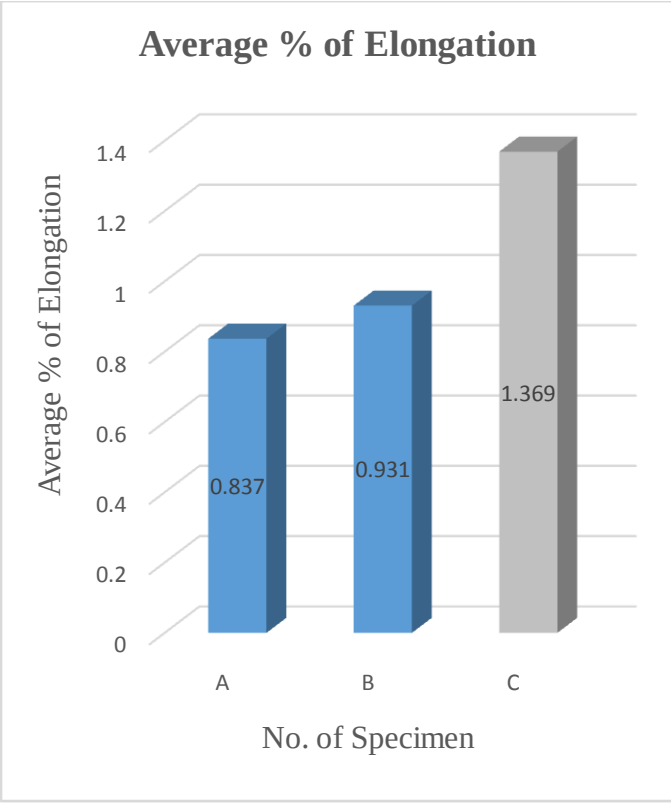


Figure.5 No. of Specimens Vs Average % of Elongation

*C. Water Absorption Test*

The Water Absorption Test of various composites with varying weight fractions. From the graph the variation of Water Absorption Test with different composite specimen with the ASTM standard dimension (20×20×3) mm.

Table.4 Before water Absorption 3 samples

| Fiber & resin weight ratio | Sample 1 | Sample 2 | Sample 3 |
|---|---|---|---|
| 35:65 | 1.36 | 1.44 | 1.35 |
| 35:65 | 1.48 | 1.32 | 1.46 |
| 35:65 | 1.48 | 1.45 | 1.53 |
| Average Weight Before Test in grams | 1.44 | 1.40 | 1.44 |


Figure.6 No. of Samples Vs Weight Before Test

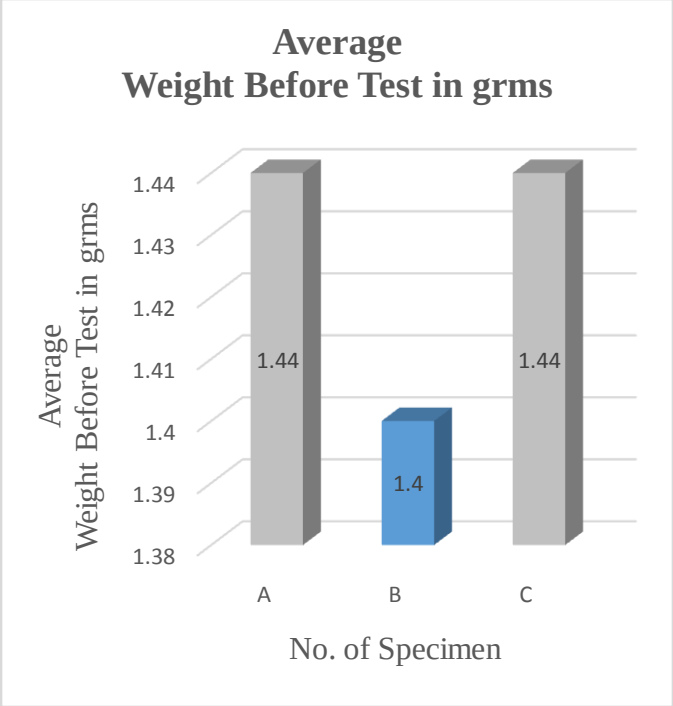


Figure.7 No. of Samples Vs Average Weight Before Test

Table.5 After Water Absorption 3 samples

| Fiber & resin weight ratio | Sample A | Sample B | Sample C |
|---|---|---|---|
| 35:65 | 1.42 | 1.67 | 1.46 |
| 35:65 | 1.5 | 1.65 | 1.49 |
| 35:65 | 1.59 | 1.61 | 1.62 |
| Average After Test in grams (48 hrs.) | 1.50 | 1.64 | 1.52 |

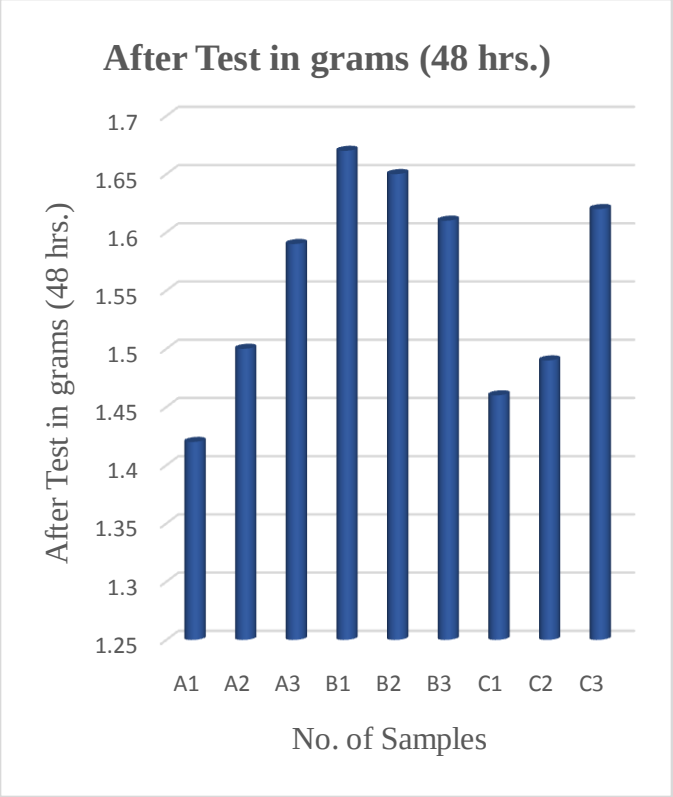


Figure.8 No. of Samples Vs Weight After Test

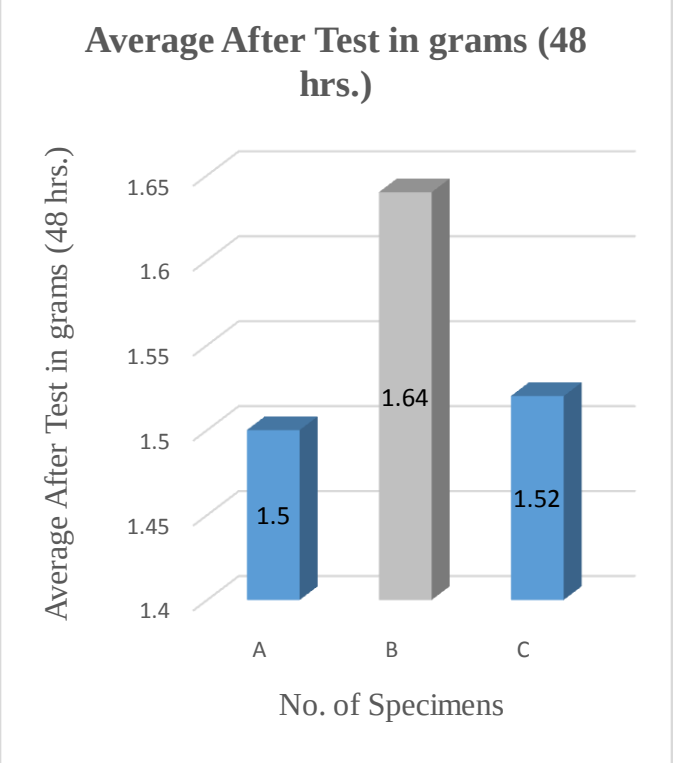


Figure.9 No. of Specimens Vs Average Weight After Test

## IV. CONCLUSION

The present work describes the mechanical properties of Banana, Sisal & Flax fiber reinforced hybrid epoxy composite. Polymer Matrix Composite (PMCs) has the various natural fibers as the reinforcement phase was fabricated successfully.

The sample specimen B combination of B+S+F+M of ratio 10:10:15:65 have the higher flexural modulus compared to other Specimen A & C.

The sample specimen C combination of B+S+F+M of ratio 10:15:1510:65 have the highest % of Elongation compared to other Specimen A & B.

The sample specimen B combination of B+S+F+M of ratio 10:10:15:65 have the higher water absorption after the compared to other Specimen A & C.

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