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ANALYZING NATURAL FIBER EXPERIMENTALLY WITH EPOXY RESIN

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Abstract:

This study investigates composites using natural fibers (such as banana and sisal) combined with epoxy resin to produce laminating boards. The manufacturing process employed the wooden mold fiber stitching method, where fibers are embedded in a mold and saturated with epoxy resin, ensuring uniform distribution and strong bonding. Chemically treated fibers exhibited significantly enhanced flexural strength, indicating improved adhesion between fibers and the epoxy matrix. Orientation studies revealed that configurations like 0-90 degrees and 45-45 degrees consistently demonstrated superior tensile and flexural strengths, emphasizing the importance of fiber alignment in optimizing mechanical properties. Layering techniques, by adding multiple fiber-reinforced epoxy resin layers, not only increased material thickness but also enhanced structural integrity and resilience against potential failure modes. These findings underscore the potential of natural fiber-reinforced epoxy composites in various applications such as automotive components, construction materials, and aerospace structures. Further research could focus on optimizing fiber treatment methods, exploring additional orientation configurations, and refining layering strategies to maximize performance and durability in specific engineering applications.

Index Terms- Sisal fiber, Banana fiber, Natural Fiber Composites.

1. Introduction:

Natural fiber composites have drawn interest in recent decades as a synthetic substitute from academics and industry world wide.When making laminates, waste resources like banana fiber and sisal fibers were utilized as increasing reinforcement materials, and epoxy resin was used as a binder. Following fabrication, samples were evaluated for both tensile and flexural strength using orientations like 0-90 and 45-45.

2. Literature survey:

Baharin et al. [1], laminated boards were made from the stem and leaves of bananas. As the number of layers increases, so do the tensile strength, impact strength, and elastic modulus, indicating that the qualities tested parallel to the fiber orientation are greater than those measured perpendicularly.

Badrinath et al. [2] employed sisal and banana fiber as reinforcement materials to increase the efficacy of natural fibers. The laminate is made by hand using the lay-up method, and it is tested for tensile, flexural, and water absorption properties.

Kikuchi [3] claimed that environmentally friendly composites were created using the spray-up molding process and jute fiber. Because spray up molding equipment is so versatile, it can readily create a wide range of composites.

Ramesh et al. [4] natural sources have undeniable benefits over synthetic materials, including being less expensive, non-toxic, and requiring less waste management. Samples of various fiber types were created using the hand layup technique.

Dixit et al. [5] suggested that researchers are paying close attention to potential reinforcement options and that natural fibers may be easily and affordably produced. Natural fibers with chemical treatment perform better in terms of impact and fatigue strength.

Rajesh et al. [6] was to created biodegradable composites made of natural fibers using PLA as a matrix and short jute fiber as reinforcement. Tensile characteristics demonstrate that, when fiber loading increased, treated fibers performed better than untreated fiber composites.

Thus, after reviewing all of the studies on natural fiber, laminated boards were made using the hand layup technique. For this reason, there is room to improve the laminating board fabrication process using a different approach. The goal of this research is to fabricate laminating boards utilizing the wooden mold fiber stitching technique.

3. Methodology:

A. Picking the Best Natural Fiber.
Natural fiber composites are made of a variety of natural fibers found in the world. There are some that have excellent mechanical and reinforcing qualities. We have used natural fibers with good mechanical qualities, such banana and sisal, for our laminate preparation. These fibers are also easily accessible in the neighborhood and have excellent qualities at a very affordable cost.

B. Chemical Treatment and Bleaching.
Bleaching is a crucial step in both enhancing the strength of the fibers and eliminating lignin that is present on them. Alkali treated chemically with sodium hydroxide and peroxide were chosen. These fibers are successfully treated for one day with a 5% by weight NaOh solution before being cleaned with distilled water. Following another repetition of this procedure for the peroxide treatment, the fibers were ultimately dried in the sun.

C. Removing the bleached fibers.
Extraction of treated natural fibers for separation purposes came next, following chemical treatment. The extraction is carried out manually. all of the banana and sisal fibers were separated into single fibers.

C. Eliminating the bleached strands.

After chemical treatment, treated natural fibers were extracted for separation purposes. The process of extraction is done by hand. The fibers from sisal and bananas were all divided into single strands.

E. Laminate Fabrication.

Following the construction of the wooden mold, the laminate was prepared using epoxy resin with grades LY556 and HY917, which served as the hardener and Araldite, respectively. orientations of 0-90 degrees and 45-45 degrees, respectively, were obtained for the two plates. The fibers were fastened to the mold using the mold's nails. There is a 900 layer following a 00 layer. Following the completion of each layer, layers were covered with epoxy, which is an araldite and hardener mixture. The plate is covered with some weight to ensure that its thickness is consistent, and it is ready after eight hours. In a similar manner, a second laminate with an orientation of 45 degrees was created.

F. Testing of laminate.

Tensile and flexural tests were performed on the prepared laminating plate to examine its behavior under loading. The specimen for the tensile test was created in the shape of a dumbbell in accordance with ASTM D638-2003, and the specimen for the flexural test was created in accordance with ASTM D790-2003.

4. Results:

As previously indicated, laminates were tested for tensile strength in accordance with ASTM D 638-2003 and flexural strength in accordance with ASTM D 790-2003. The behavior of specimens under loading conditions is depicted in the following figures.

A. Sisal-banana (0^0-90^0) orientation.

a) Tensile test:-

Tensile test graph for sample no. 1 and 2 are shown in fig.1

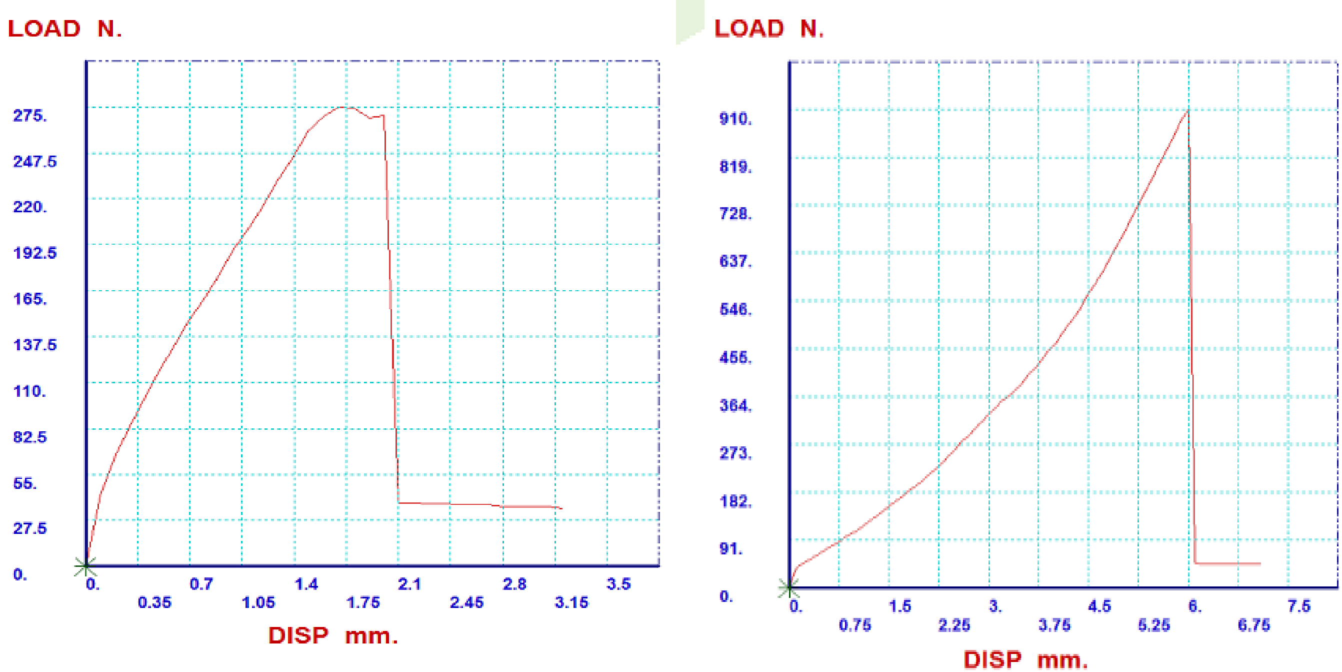

Fig.1 Load vs. displacement for tensile for samples 1 and 2.

Tensile test load cell is 980 N, speed is 10 mm/min, and corresponding tensile strength is 67.20 MPa and 22.13 MPa.

b) Flexural Test:-

Flexural test graph for sample no.1& 2 are shown in fig.2 respectively.

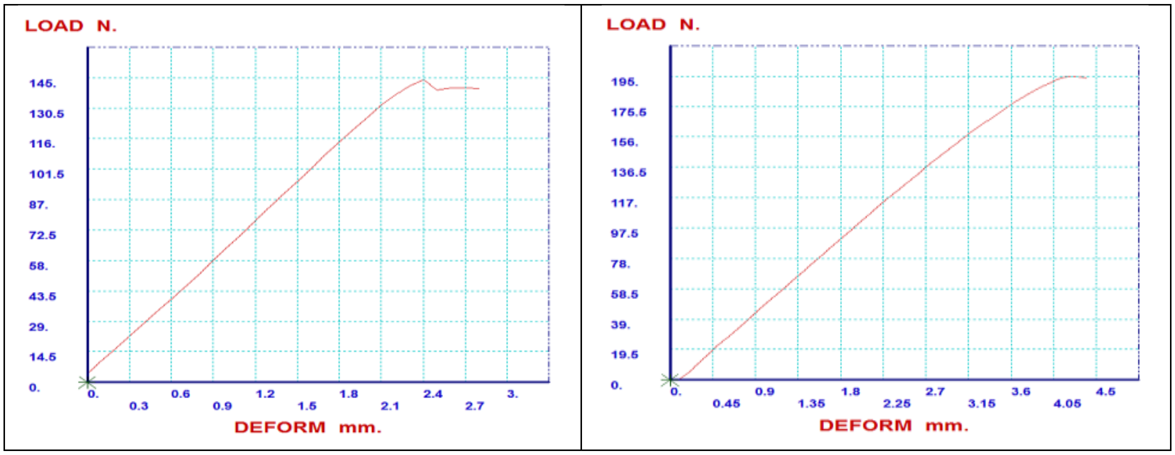

Fig.2 Load vs. displacement for flexural test.

The load cell for the flexural test is 980 N, the peak load is 144.64 N, the speed is 5 mm/min, and the flex strength is 62.294 MPa and 84.181 MPa, respectively.

B. Sisal- banana (45^0-45^0) orientation.

a) Tensile test:-

Tensile test graph for sample no. 1 and 2 are shown in fig.3

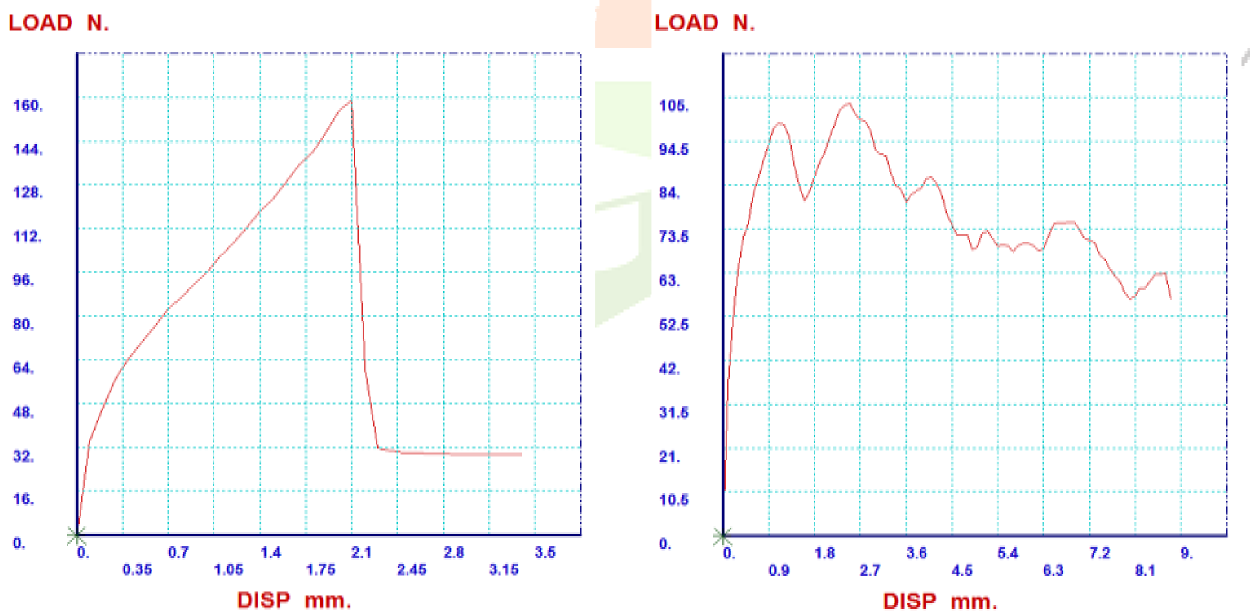

Fig.3 Load vs. displacement for tensile test.

The maximum load for the tensile test is 158.956 N, the speed is 10 mm/min, the load cell is 980 N, and the tensile strength is 13.78 MPa and 25.57 MPa, respectively.

b) Flexural Test:-

Flexural test graph for samples 1 and 2 shown in fig.4 respectively.

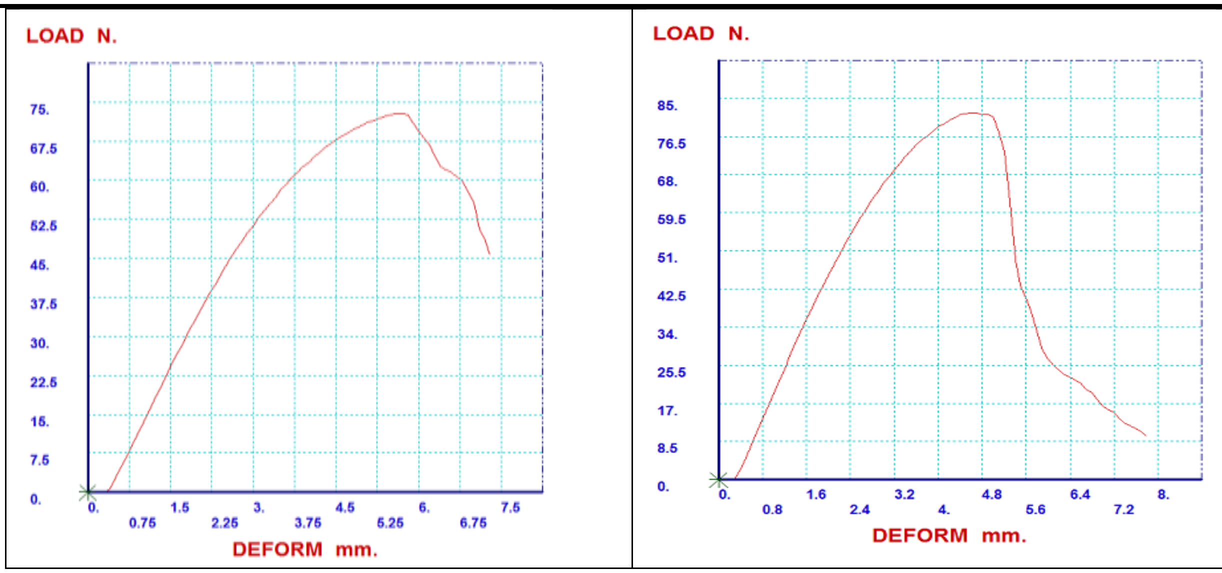

Fig.4 Load vs. displacement for tensile test for sample 1 & 2.

The specimen oriented as 450-450 samples was subjected to a flexural test. The specimen's load cell was 980 N, its speed was 5 mm/min, its peak load was 72.814 N, and its flexural strength was 47.11 MPa and 47.22 MPa, respectively.

Table no.1 Results of tests

Sr.no.	Sample no.	Tensile Strength (MPa)	Flexural Strength (MPa)
1	0^0-90^0	22.13	62.294
	0^0-90^0	67.20	41.181
2	45^0-45^0	25.57	47.22
	45^0-45^0	13.78	47.11

5. Conclusion:

Better results for a new fabrication approach, such as the wooden mold fiber stitching method, are shown by the experimental investigation of natural fiber with epoxy glue. Good orientation for laminate manufacture is also provided by this technology. The study of the results leads to the following conclusion:

1. The 0-90 orientation yields better results for the flexural test.
2. The 0-90 orientation yields good results from the tensile test.

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