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A Study on Investigation of Flexural and Impact Properties of Aloe Vera Fiber Reinforced Epoxy Composites

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Abstract

The purpose of this research is to estimate the tensile properties of Aloe Vera Fiber composites. **T**his research is done to fabricate aloe Vera Fiber Reinforced epoxy composite by varying compositions of fiber layers. The methodology used for the fabrication of composites is hand layup process. Flexural test, Impact tests and hardness tests were performed as per ASTM standards .From the results of the testing process, it has been found the 3rd composite specimen that has 3 layers of Aloe Vera fibers exhibited superior properties.

Keywords: Aloe Vera, Epoxy resins, ASTM, flexural properties, Impact.

1. Introduction

Natural fibers are eco-friendly compared to synthetic fibers such as glass fibers. Thanks to the advantageous properties of the Natural fibre reinforced polymer composites that lead them being used in automobile components, construction industry, and aerospace parts. Nowadays, automotive industries are focussing on developing eco-friendly materials for their components. Hence, study and development of newer materials namely Nano composites, fiber composites and metal matrix composites is necessary which are having better mechanical behaviour and other properties. The bamboo fibres are utilized in many fields such as building and construction industry like door, windows panels, wall partition, sports, aerospace, railway and automotive sectors like setbacks. In comparison with the basic composites , the advantages that the bamboo fibres has are low weight , low requirement of raw material , cheap and cost effective ,as optimized mechanical properties can be obtained ,good resistance to moisture and it is also available in semi-finished and finished state .

Sapuan et al. fabricated woven banana fibers reinforced with epoxy matrix composite. Venkateshwaran and ElayaPerumal examined several works in composite reinforced with banana fiber and evaluated physical properties, structure, and application of the same. Shibata et al. investigated the influences of the volume fraction on flexural properties of kenaf and bagasse composites. Yuan et al. witnessed that introduction of kevlar Fibre enhanced the mechanical properties in Wood Flour/PP composites. Perremans et al found that the tensile stiffness of bamboo fibre reinforced epoxy composites is hardly influenced by the discontinuity patterns. Satish et al found that influence of fibre orientation on density of composites is less. Vaghasia et al found that the mechanical properties of WBGP hybrid composite depends on the effect of fiber-polyester percentage variation. Thakur et al fabricated Bamboo fiber reinforced with varying percentage of CNT in the epoxy resin composite and evaluated the mechanical characteristics of the same. Khan et al fabricated bamboo fiber reinforced epoxy matrix composite using 6% NaOH treated bamboo fibers showed maximum ultimate tensile strength. Biswas et al observed that hardness of composites reaches a maximum value when the fibre orientation angle is 30°.

Among these, Aloe Vera is a well-known plant whose fibers are mainly used in a wide variety of structural applications like building and construction. Many researchers have done many researches with Aloe Vera and their composites. Some of the important mechanical properties of Aloe Vera fibre are the elastic recovery, strength of the fibre, breaking extension of fibre in dry, moisture regain, resistance to heat degradation and tensile strength of the fibre. Aloe Vera generally grows in arid climates and can be seen vegetated in small pots in houses can be used as reinforcements in composites and effectively when after treatment. Its potential usage should be concerned in manufacturing field by reinforcing with plastic.

2. Materials and Methods

Combination of Aloe Vera Fibers, and Epoxy resin in the presence of a hardener leads the way to excellent bonding properties. The specimen was prepared using Aloe Vera Fiber as Reinforcement by hand layup process (figure 1). The dimensions of the specimen was set to 250*250*5 mm. Three distinct composites namely 1, 2 & 3 were prepared with 1 layer, 2 layers and 3 layers respectively. The mats have been infused with the resin and fibers were allowed to dry. The Fiber composites were bathed in the thinner solution and were hence freed from impurities. The Fibers were then placed on the die and were spread over the epoxy resin. They were then allowed to settle for a period of 48 hours.

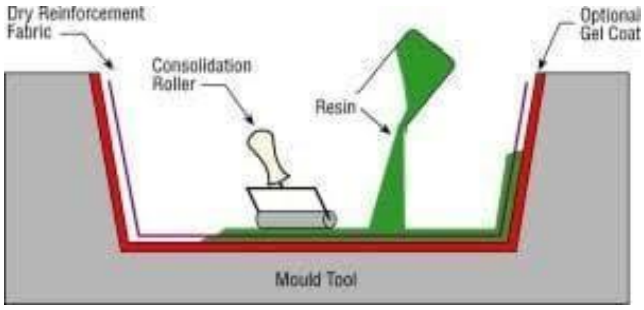

Figure 1: Hand Layup Method

3. Experimental techniques

3.1. Flexural test

The flexural test has been carried out, on the composite specimens 1,2 and 3, as per the American Society for Testing and Materials (ASTM) D790 standard using a universal testing machine (UTM) setup to determine the flexural strength at room temperature. The specimen that was made according to the ASTM: D790is shown in figure 2, and the test was carried out by applying load until the specimen failed.

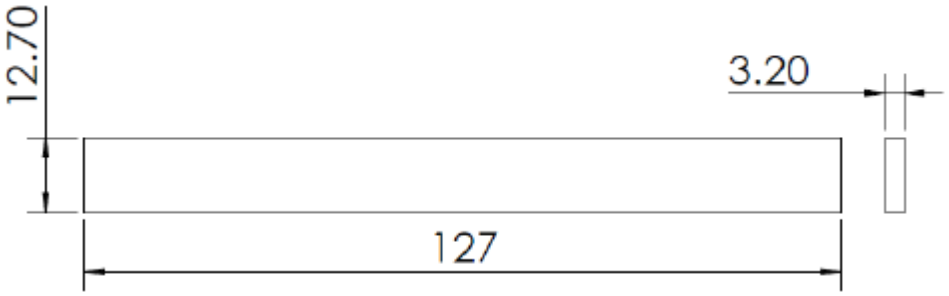

Figure.2. Flexural test specimen

3.2. Impact test:

The Izod-charpy test is done to calculate the impact energy. The specimen were prepared as per ASTM: D256 standard Figure 3 shows impact test specimen.

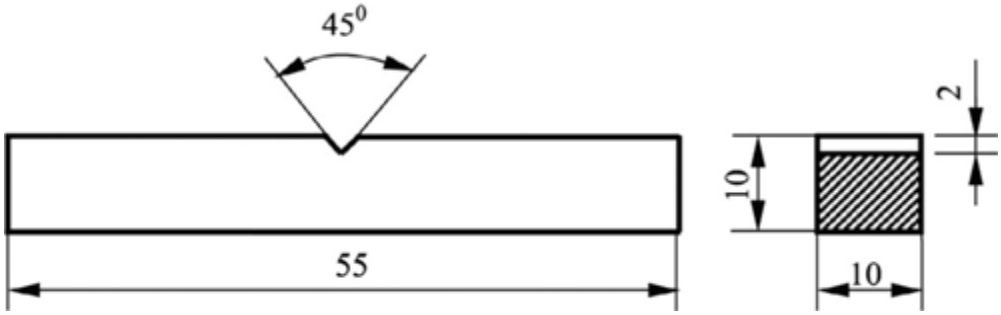

Figure.3. Impact test specimen

4. Results And Discussion

4.1. Flexural strength: From the experiment, it is seen that the specimen 3 possesses the highest flexural strength and the greatest displacement among the three specimens. Table 1 demonstrates the results of tests and figure 4illustrates Stress vs strain graph of composite 3.

Table 1 Result of flexural test

COMPOSITES	MAXIMUM FLEXURAL BREAKING LOAD (kN)	MAXIMUM DISPLACEMENT (mm)
Composite 1	0.32	7.2
Composite 2	0.37	8.1
Composite 3	0.49	8.9

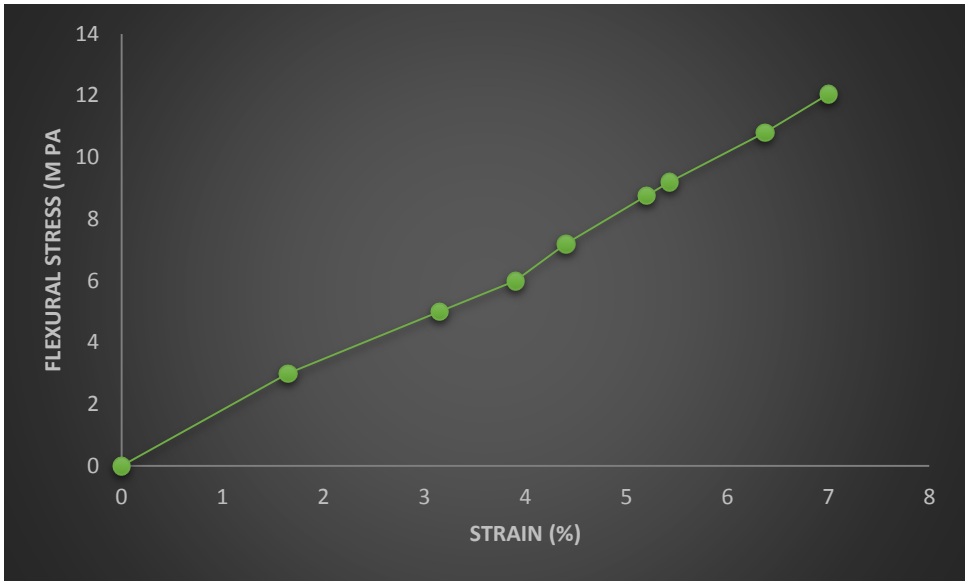

Figure 4. Flexural Stress vs strain graph of composite 3

4.2. Impact strength:

The Charpy impact test has been carried out for the specimens. It has been witnessed that the highest impact strength was recorded for specimen 3. Figure 4 displays the impact test result .Table 2 shows the impact test experimental results.

Table 2 Result of Impact test

COMPOSITES	IMPACT STRENGTH (J)
Composites 1	1.2
Composites 2	1.8
Composites 3	1.9

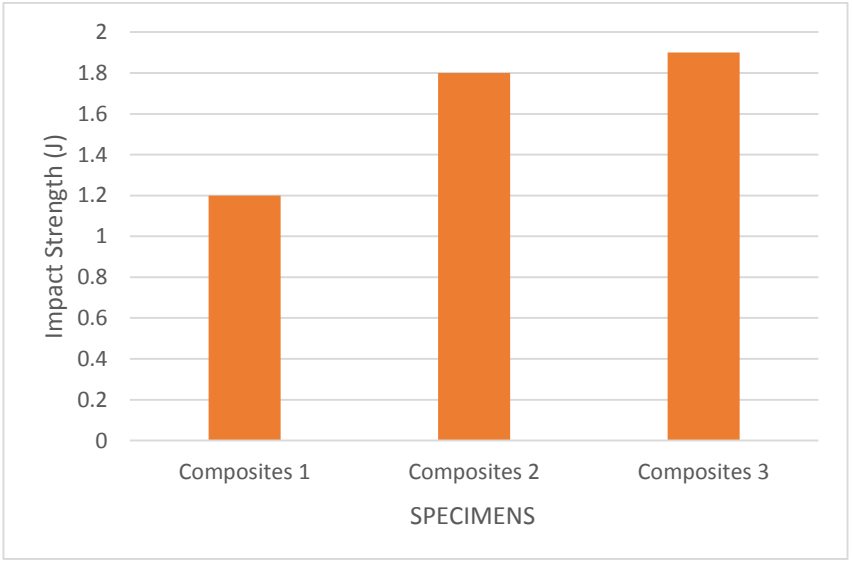

Figure 5 Result of impact test

5. Conclusion

Fibre-reinforced composites have numerous applications in our daily life because of their usability and strength. Fibres oriented in the same direction produce enhanced strength properties. Natural fibres can be used as replacements for synthetic fibres. Natural fibres are obtained from things which we consider as waste, they are eco-friendly and easily available. They are mainly used in aerospace, automotive and construction industries as a result of its less weight, enhanced specific strength and toughness towards fracture. In this work, the properties of Aloe Vera fiber reinforced polymer composites were investigated and the outcomes are as Flexural test, Impact tests and hardness tests were performed as per ASTM standards. From the results of the testing process, it has been found the 3rd composite specimen that has 3 layers of Aloe Vera fibers exhibited superior properties. The three layered Aloe Vera Fiber composite was found to have better properties than the two layered and the single layered composites.

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