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MECHANICAL PROPERTIES OF FALSE BANANA REINFORCED EPOXY COMPOSITE

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Abstract: - *Natural fiber composites we mean a composite material that is reinforced with fibers, particles or platelets from natural or renewable resources. False banana (Ensete) is important by-product of Ethiopian country farmers used for food purpose and its fiber for rope; furnish material, roof with polymer composite. False banana fiber reinforced by epoxy is increase mechanical properties, surface finish and less water absorption than polymer composite.30% Fiber/70%Epoxy has greater tensile strength 42Mpa and impact strength 3.2J than other Fiber/Epoxy matrix.20%.The mechanical properties will be change with change in composition of fibers. False banana fiber is known for its remarkable smoothness its mixture with epoxy resin lead towards better surface finish with desired strength. From all the results and comparisons we can conclude that the fabricated false banana epoxy composite which has light weight and has good mechanical properties.*

Key word: - *False Banana Fiber, Epoxy, Tensile Strength, Impact Strength*

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1. Introduction

Natural fiber reinforced composites have a good potential as a substitute for wood-based material in many applications like automobile, electronics, structural and etc materials [1].The use of banana fiber in nowadays become popular specially in Asian country like India, Indonesia, Malaysia, to replace metal, alloys materials, glass fiber; as well as due to its advance benefit like recycling, biodegradable and eco-friendly [1], [5]. So many researcher are tested the different properties of banana fiber and its composite, But Ethiopian banana which is very similar to False banana stem but different in some case is not considered since it's not popular in most country, by nature noticed that banana has strong and flexible root than false banana's root without test result manually. So since this banana is more popular in Ethiopia this research present the evaluation mechanical properties of this plant in form of epoxy composite. Specimen tested for tensile, impact and flexural strength with corresponding testing method [6]. Using natural fibers as reinforcement for polymeric composites introduces positive effect on the mechanical behavior of polymers [4]. A composite material can be defined as a combination of two or more materials that results in better properties than those of the individual components used alone. In contrast to metallic alloys, each material retains its separate chemical, physical and mechanical properties. The reinforcing phase of the composites provides the strength and stiffness, to make them harder, stronger and stiffer than the matrix. The reinforcement is usually in the form of a fiber or a particulate. fiber orientation on mechanical properties of sisal fiber reinforced epoxy composites. In this work sisal fiber is used as reinforcement which treated with NaOH solution for enhancing the bonding strength between fiber and resin by removing moisture contents [7].The length-to diameter ratio is known as the aspect ratio, and can vary greatly for fibers because the length of the fiber is much greater than its diameter. Continuous fibers have high aspect ratios, while discontinuous fibers have low aspect ratios, and the orientation of continuous fiber composites normally is perfect, while discontinuous fibers generally have a random orientation. In general, the smaller the diameter of the fiber, the higher its strength, but the cost increases when the diameter becomes smaller. In addition, smaller diameter fibers have greater flexibility, and are more amenable to fabrication processes such as weaving or forming, across the radius [11], [12], [14]. Natural fiber reinforced epoxy resins composite have some automotive application which does not need a very high mechanical performance, but need light weight and recyclability such as interior panel [3].

2. Material and Method

2.1 Materials

A. Natural Fibers (False Banana)
B. Epoxy resin (GP)
C. Hardener(HY-951)
D. NaoH (PALLETS 93% CH880)
E. Water (H_2O)

2.2 False Banana fiber extraction

Mature False Banana pseudo-stem was obtained from farm and was cut into length of 500 mm the stems from False Banana plants were selected from an 11-month-old plantation. The plantation is located 1,050 meters above sea level and the stem of False Banana is cut and extracted by hand by using wood lumber and another sharp wood after extracted the fiber dry in the sun. False Banana fiber is extracted from southwestern of Ethiopia.

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2.3 Fiber preparation

The quality of a fiber reinforced composite depends on fiber-matrix interface because of this acts as a binder and transfers stress between the matrix and fibers. Bonding between fibers and binder can be increased by chemical treatment of fibers using chemical agent like sodium hydroxide (NaOH). Water by volume is added with 2% of NaOH for treatment process. Fibers are soaked in the alkaline solution for 24 hours, then washed thoroughly with distilled water and dried for 24 hours to remove residues of alkali. Bonding property can be improved by wetting of fibers with the matrix. Chemical treatment of fibers is necessary to improve mechanical properties and bonding between fiber and matrix.

2.4 Preparation of epoxy resin (GP)

Epoxy resin density of 1.15-1.20g/cm³, mixed with hardener density of 0.97-0.99g/cm³, is used to prepare composite material is purchased from local market.

2.5 Pattern:-The pattern is designed by as per ASTM standard. The pattern is made up of mild steel. The pattern Size is (229 x 229 x 25) in mm. The pattern consists of three parts.

Figure 2.1 Mould Pattern

2.6 Mold preparation

a. Extracted the fiber
b. Fiber treatment by using(NoaH and distilled water until neutral PH is gained)
c. Cut fiber (6-9)mm
d. Mixing fiber and epoxy within calculated fiber/epoxy ratio and cold compression mold is taken.
e. Mold release
f. Sample composite

We pour mixture of fiber epoxy mixture then we press the mold on press machine for consolidation and this sample is then left for 24 hours. The composite gets dried up in 24 hours in which the sisal fiber and the polymers adheres itself tightly in the presence of hardener. After a day we put out the mould from the press machine. Then the mold steel lower attachment (plate) is slowly and gently hammered on the boundary of its attachment when the top (lid) and the composite separate out. Then carefully plastics are removed from the steel mold. Now we have the composite.

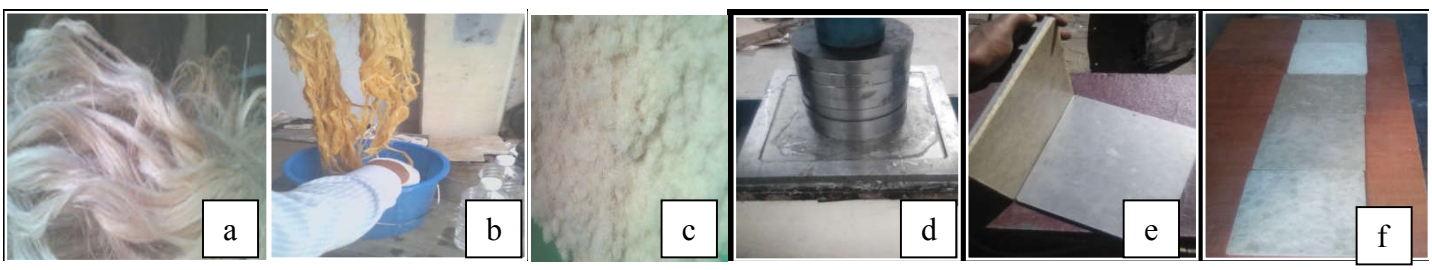

Figure 2.2 Mold Preparation

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3 Tests, Results& Discussions

3.1 Tensile Strength Test (ASTM D3039/D3039M)

The primary objective of this test was to evaluate the in-plane tensile properties of sisal fiber composites. For each sample, 5 specimens were tested in each machine and cross-machine direction each specimen was 25 by 250 mm by during the test the specimens were placed in the grips of UTM and axial load is applied through both the ends of the specimen. Typical points of interest when testing a material include: ultimate tensile strength (UTS) or peak stress; The cross-head speed used was 0.5 mm/min, and gauge length was 200 mm. Load-elongation curve, breaking load, peak stress and % strain at peak stress were acquired in real time by machine and provided at the end of each test Typical specimen under tensile strength test is shown in figure 3.2 The appropriate American Society of Testing Materials (ASTM) standards were followed while preparing the specimens for False Banana fiber reinforced epoxy composite test and their values are illustrated in figure 3.3

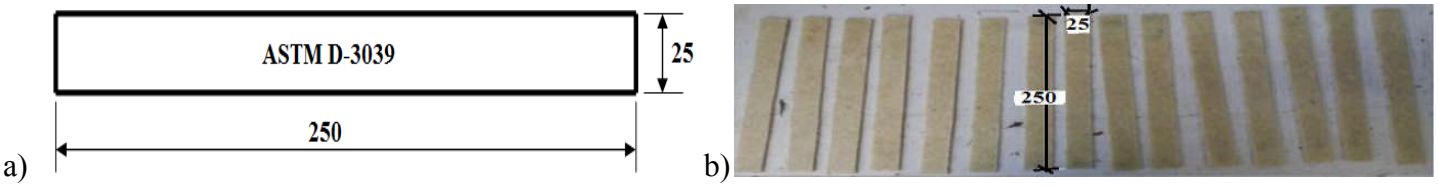

Figure 3.1 a) Dimension of Tensile Test Specimen b) Tensile Test Specimens

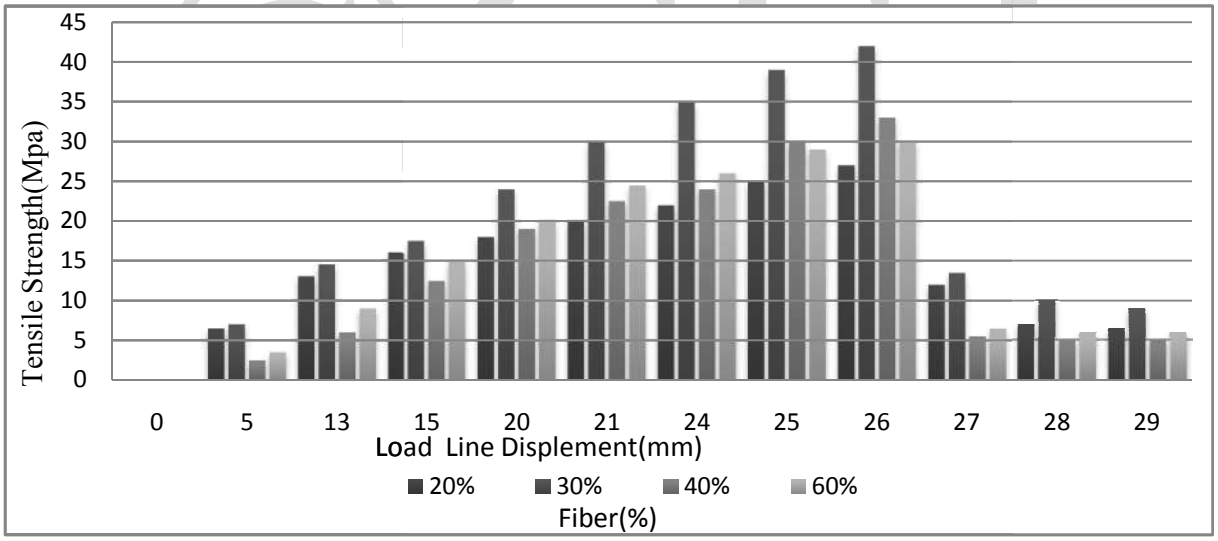

Figure 3.2 Tensile strength Test result

3.2 Impact Test

In the impact test the energy needed to fracture the element was measured i.e. the ability of a material to withstand fracture was found. In this test specimen was loaded in the testing machine until it fractures or breaks. So; hence toughness and yield strength was found. The Charpy impact test specimen was prepared as per the ASTM D-256 and as per ISO180 standard. The specimen is under impact load so test extensively uses to determine the impact resistance of the material. The dimensions of the specimen is 55mmx10mmx3mm using pendulum at room temperature on impact testing machine, model- SI42, at impact energy of 150J. This test was conducted in Addis Ababa University, Material testing lab [9].

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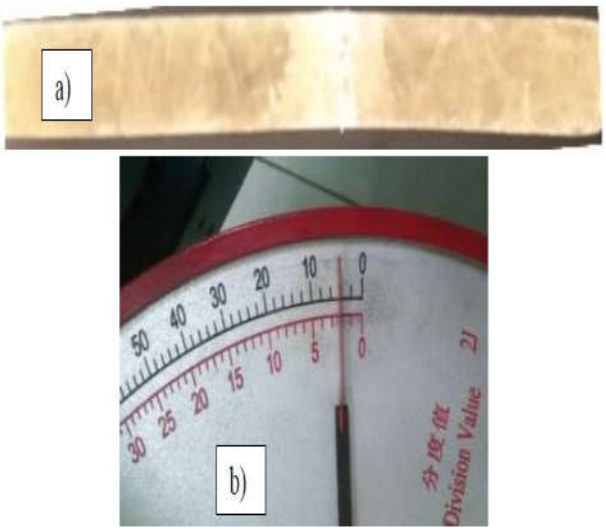

c)

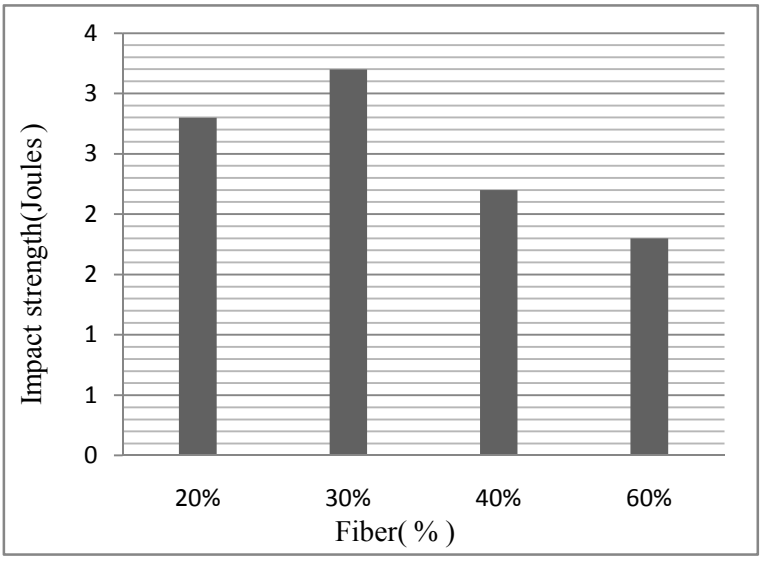

Figure 3.4 Figure 3.3 a) Impact Test Specimen b) Impact Testing Machine

Comparison of Impact strength of composite

3.3 Result and Discussion

From testes result the value of maximum tensile strength and impact strength are presented in the table 3.1 based on the maximum values of the five specimens for each test condition.

Fiber	Maximum Tensile Strength(Mpa)	Impact Strength (Joules)
20% Fiber/80%Epoxy	27	3
30% Fiber/70%Epoxy	42	3.2
40% Fiber/60%Epoxy	33	2
60% Fiber/40%Epoxy	30	1.8

Table 3.1 testes result the value of maximum tensile strength and impact strength

3.4 Conclusion

- ✓ The mechanical properties will be change with change in composition of fibers.
- ✓ 30% Fiber/70%Epoxy has greater tensile strength and impact strength than other Fiber/Epoxy matrix.
- ✓ 20% Fiber/80%Epoxy has less tensile strength and impact strength than other Fiber/Epoxy matrix.
- ✓ False banana fiber is known for its remarkable smoothness its mixture with epoxy resin lead towards better surface finish with desired strength.
- ✓ From all the results and comparisons we can conclude that the fabricated false banana epoxy composite which has light weight and has good mechanical properties.
- ✓ Building and construction industry: panels for partition and false ceiling, partition boards, wall, floor, window and door frames, roof tiles, mobile or pre-fabricated buildings which can be used in times of natural calamities such as floods, cyclones, earthquakes, etc.
- ✓ Storage devices: post-boxes, grain storage silos, bio-gas containers, etc.
- ✓ Furniture: chair, table, shower, bath units, kitchen cabinet etc.

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