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INVESTIGATION OF FLEXURAL PROPERTY OF KENAF- FLAX HYBRID COMPOSITE

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ABSTRACT

Present technological development made us to use composites which are environmental friendly and biodegradable those are plays vital role in automotive, construction and aero space applications. In this work the flexural properties of Flax and Kenaf mono fibre and hybrid composite of both are investigated. The composite are fabricated using hand layup method. The flexural property of composites is compared with the single fibre suspended natural composite made of their ingredients individually. The comparison shows the effect of hybridization on various aspects. The hand layup technique of manufacturing used here also influences in forming properties of the composites. Finally crack propagation and shearing styles are discussed using the Scanning electron Microscope (SEM) images of the tested fibre composite specimens.

Keywords: kenaf fibre, flax fibre, hybrid composite, flexural property.

1. INTRODUCTION

Yousif *et al* [1] compared the flexural properties of untreated and treated kenaf/epoxy composites and showed that the flexural strength enhanced by 36% and 20% for epoxy reinforced with treated and untreated kenaf fibre respectively. Sapuan *et al* [2] studied the mechanical properties of soil-buried kenaf fibre reinforced thermoplastic polyurethane composites. The authors reported that the tensile strength of the composite reduced ~16.14 MPa and that there was no significant change in flexural properties due to moisture absorption by fibre in soil burial test. A similar result of deterioration of mechanical properties due to moisture in kenaf fibre was observed by Ghani *et al* [3]. Benjamin Masseteau *et al* [4] presented the tensile tests results on ‘‘wet’’ and ‘‘dry’’ flax yarn and showed the variation of flax fibre modulus of elasticity due to moisture content and compared these results with the tensile tests of ‘‘wet’’ and ‘‘dry’’ fiber of flax fiber reinforced epoxy unidirectional composites. Dry fibres showed better modulus of elasticity and wet fibres showed good adhesion between matrix and fibre. Alkalizing the kenaf fibres was found to give better flexural strength, impact strength and tensile strength for polymeric composites [5-9]. The moisture content of flax fibre depends on the ambient temperature and relative humidity as flax fibre is a hydrophilic material [10,11]. Investigation on mechanical properties on fiber composites is done and it is concluded that hybrid composite has high strength. [12-15]

2. FABRICATION PROCEDURE

In this work Hand layup method is used to fabricate the composites. Initially releasing agent poly-vinyl alcohol is applied over the inner surface of the mould. For effective binding, LY556 epoxy resin and HY951 hardener mixture is applied between two layers. GFRP laminates are used on both sides of the composite. On the bottom most GFRP layer the resin-hardener mixture is applied over which flax fibre layer and a layer of kenaf fibre is placed. Finally a layer of flax and GFRP is laid on the top most layer of composite. The complete structure is compressed by applying a uniform load of 15 kg until the composite sets. The procedure is repeated for GFRP + flax and GFRP + kenaf mono composites.

a) Materials used

In this work kenaf and flax fibers are used to fabricate the composite. Glass Fiber Reinforced Plastic (GFRP) laminates are used as outer most layer of the composite structure. Epoxy resin and HY951 hardener are used for preparing the composite. The mixture of both forms the prime constituent that binds various layers of fibre. As recommended an optimum mixing ratio of 9:1 between resin and hardener is used. The mixture provides the best binding property at room temperature of 27-30°C.

3. MECHANICAL TESTING OF COMPOSITES

a) Flexural test

Flexural testing requires a special fixture in universal testing machine. Three point load setup is used in this test, where the ends are supported and the load is given at the midpoint. Specimen for this test is prepared as per ASTM: D790 standard as shown in Figure-1.

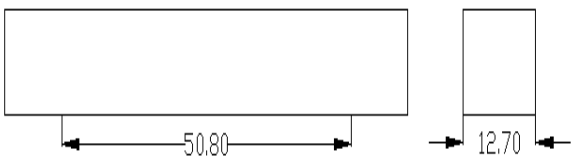

Figure-1. Schematic diagram of flexural test specimen.

Flexural properties like break load, maximum deflection, percentage elongation and ultimate tensile strength of the composites namely Kenaf + GFRP, Flax + GFRP, Kenaf + Flax + GFRP are noted.

4. RESULTS AND DISCUSSIONS

The flexural properties including flexural break load, maximum displacement and ultimate flexural strength of the composites namely Kenaf + GFRP, Flax + GFRP, Kenaf + Flax + GFRP are shown as graph in Figure-2. It is found that the hybrid composite Kenaf + Flax + GFRP has higher flexural strength than the others. The Load- Displacement curve increases linearly with respect to displacement but with varying slopes. The hybrid composite bears more load also it has the more displacement. So, it strains much before it failures. The Figure-3 shows the comparison between the 3 composite specimens under flexural loading condition.

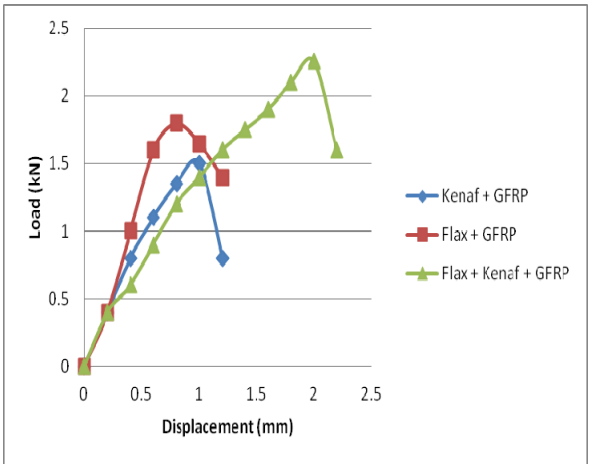

Figure-2. Load vs. displacement graph (Flexural Test).

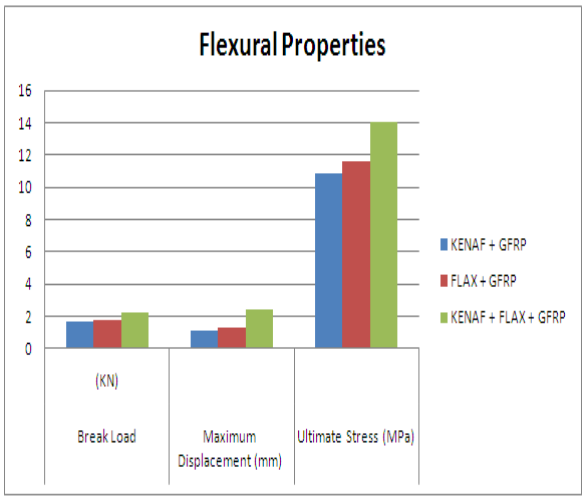

Figure-3. Comparison of flexural break load, maximum deflection and ultimate stress (Flexural).

5. MICROSTRUCTURE ANALYSIS USING SCANNING ELECTRON MICROSCOPE

The internal morphology analysis of tested specimen is carried out using Hitachi S-3400N Scanning Electron Microscope available at Anna University, Chennai. Specimen for flexural test is taken for carrying the analysis. The specimen is gold coated with a thickness of 15-20 nm using an ion-sputter device attached to microscope.

a) Flexural test image of kenaf fibre

The SEM image of the flexural tested specimen is shown in the Figure-4. The figure shows clearly the inter phase de-lamination of the fibres after the flexural load being applied.

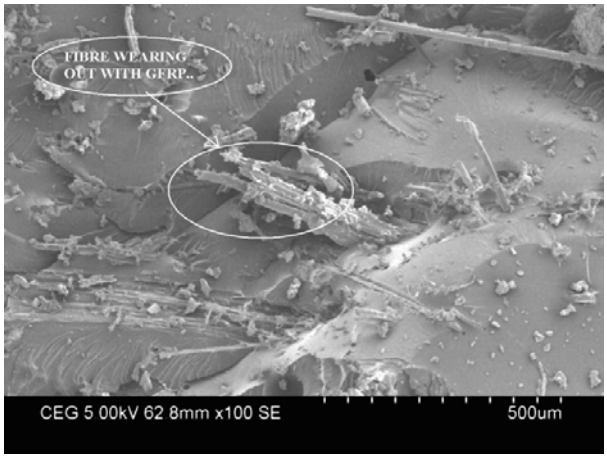

Figure-4. SEM image of flexural tested kenaf composite specimen.

b) Flexural test images for flax fiber

The SEM image of the Flax after failure under flexural load is shown in the Figure-5. The presence of micro voids in the specimen is mainly due to hand lay-up fabrication. The adhesion between the fibre and the resin is good and so the propagation of crack occurs only through the voids which results in higher flexural strength.

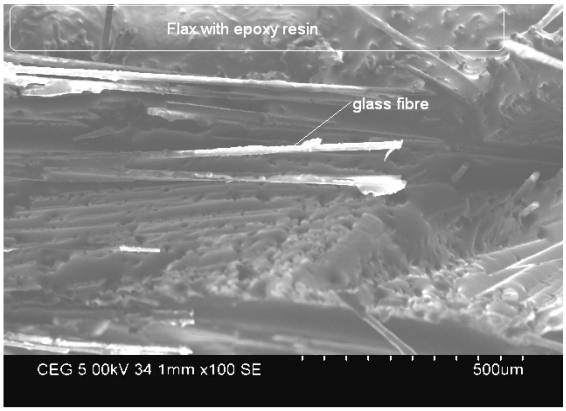

Figure-5. SEM image of flexural tested flax composite.

c) Flexural test image of hybrid composite

The Figure-6 shows the image of hybrid composite after failure flexural test. The flexural load is concentrated more on Kenaf and flax fibres resulting in complete breakage of the fibres. For the entire laminates, the breakage of fibres at the point of application of load is uniform. The above SEM images clearly explains the microstructures of the specimen after the mechanical testing and also the defects present in the specimens like void, air bubbles. These defects can be overcome by using proper composition of epoxy resin, fibres and also by proper hand lay manufacture method.

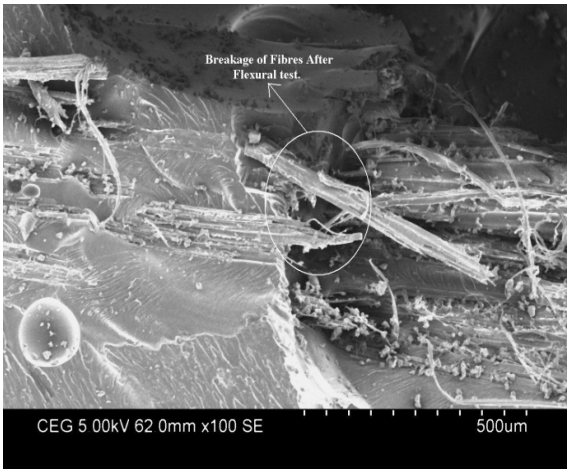

Figure-6. SEM image of flexural tested hybrid composite specimens.

6. CONCLUSIONS

In this work the flexural property of kenaf-flax mono composite and hybrid composite is performed. In general it is concluded that hybrid composite has better properties as compared to mono composite. The following are the conclusions that were observed from the test results:

- It has been observed that hybridizing kenaf fiber with flexural strength of 10.83 MPa with Flax fiber of flexural strength 11.59 MPa would result in potential increase in flexural strength of hybrid composite to 14.06 MPa.
- The effect of hand layup process which leads to early breakage of the composite is discussed with the help SEM images.

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