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Compressive and impact properties of kenaf/hemp and E -glass fiber hybrid composite

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***Abstract*---**The use of fiber reinforced composites with in aerospace and automotive industries have exploded recently due to environmental issues and health dangers caused by synthetic fiber during disposal and production. The compressive and impact strengths of hybrid composites are presented in this research. Hand-lay-up composites of various thicknesses and combinations are manufactured, and specimens were tested as according ASTM standards. In comparison to other combinations, the compressive and impact strength of the E-Glass-kenaf-hemp-E glass combination is the highest.

***Keywords*---**Composite, glass, fiber, Hemp, Reinforcement.

Introduction

Natural fibers are being employed as reinforcements for polymer composites to replace produced strands like glass fiber because of its economic feasibility, low thickness, exceptional specific quality, and inexhaustible availability [1-5]. Sisal, banana, kenaf, hemp, as well as a variety of other plant strands are the most frequent. Mwaikambo et al. [6] investigated the history, qualities, and applications of plant fibers, finding a strong correlation among plant filament small stability

and mechanical capabilities. Hibiscus cannabinus L, sometimes called as kenaf, is indeed a biodegradable hibiscus harvest. The prerequisites required for the formation of kenaf strands with nations at the base of filaments have been emphasized by Chawla [7].

As according Shibata et al. [8], the fiber lattice, as well as the process for changing the heap from of the grid to a fiber, are crucial in the execution of fiber reinforced composites. The root and qualities of hemp strands were depicted by Thomas A. Rymsza [9]. Cannabis sativa (Cannabis sativa) is just a marijuana-like plant with in Moraceae family (Mulberry).

Hemp seeds have a smooth surface as well as a crease around the circle and are spherical in shape. Glass is one of the most important types of support in polymer composites. It has an excellent electrical safety rating, a reduced temperature coefficient, and a low dielectric coefficient. Its characteristics are determined by the use of curing skills and the addition of additives. Natural fibers have recently piqued the interest of analysts as a fortification material due to their advantages over other well-known materials. They are presently used in a variety of industries, from residential to automobile. Natural fibers with a higher lignocellulose percentage, low thickness, and a higher extension rate were employed for composite construction to achieve the aforementioned goals. Anisotropic and dominant mechanical qualities are reported to exist in Unidirectional but also Nonstop regular fiber composites.

Material

Kenaf fibers are a viable reinforcement solution for biodegradable polymer composites that perform well. Because of the long fibers formed from the outer fibrous bark, the bast, it has a lot of promise for application in automotive industrial building materials. Due to strong contact between both the fiber and the resin, Kenaf fiber reinforced composites offer exceptional mechanical characteristics. As a result, kenaf fiber reinforced composites can be used instead of traditional polymer composites.

In place of glass fibers, hemp fibers are increasingly being utilized to reinforce composite constructions. These fibers, which are found with in stems of a hemp plant, were highly comparable and toughness to glass fibers, as well as being cost-effective, easy to process, and reuse. Automobile components, construction materials, or even tails are made from hemp fibers. E (glass fiber): One of the most prevalent techniques of reinforcing in polymer composites is E–glass fiber. It has a low thermal coefficient, a low dielectric coefficient, and a high electrical resistance. Both additives including curing chemicals have an impact on its characteristics. Epoxy resin has a high mechanical strength, low shrinkage, chemical stability, high diffusion density, low viscosity, and excellent electrical insulating capacity, among other characteristics. It can be reinforced with natural hemp, kenaf, and E glass fibers.

Experimental Work

The laminates are set by hand utilizing the layup technique, as shown in Fig 1. We might utilize a hand roller for measure the biker, steel run, gloves, scissors, and a hacksaw cutting edge in this technique. After the laminate has been made, it is utilized the cut individual overlays into to the desired form. The depression is square in shape. It was also used to set it up the overlays in the same way. As a discharge specialist, place a square shaped depression on a flat surface and add wax to the cavity's base. In a 1:10 ratio, mix the sap and the hardener together. After applying the wax to the pit, bind one layer of fiber to a gum for 5 to 10 minutes. After reapplying some wax to the fiber, wait 5 minutes. This method will be continued until you reach the required thickness. The laminates are given weight after they have been prepared.

(b) (c) (d) (d)

FIGURE 1. Preparation of Kenaf Laminate using Hand Lay-up Process (a) Mixing of resin and hardener (b) Applying releasing agent (c) Placing fiber on dam (d) Squeezing operation (e) Finished Laminate

Mechanical charaterisation

Compression test

To determine in-plane compressive characteristics, this approach compresses the specimen on wedge grip contacts. ASTM D695 is most suited for composites containing high-modulus fibers, such as tape as well as textile, although it can also be applied to other materials. With a gauge length of 12 to 25 mm, the test fixture provides a compressive load on the unsupported Center (0.5 to 1 inch). Figure 1 shows the compression test setup.

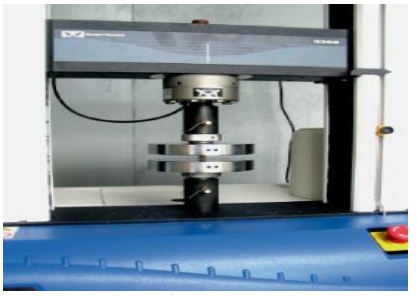

Figure 1

Izod impact experiments on a Tinius Olsen pendulum effect tester IT 504 are shown in the diagram 2. (The Izod effect has been activated.) The ASTM D256

standards were followed while inspecting samples sized 60 x 12.7 x 5mm. A pendulum with just a speed of 3.46 m/s impacts the sample as it is dropped from a height of 609.6 mm. The tester calculates and displays the effect energy absorbed either by samples.

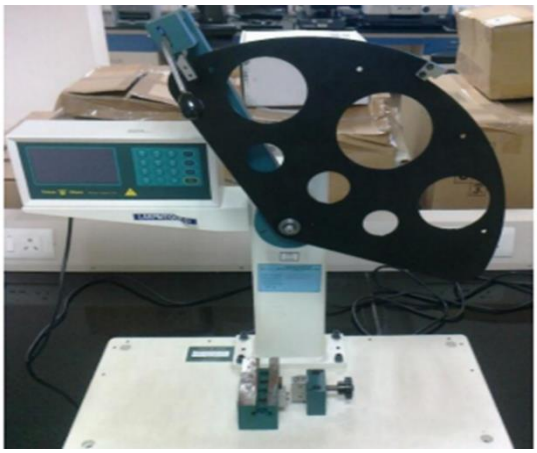

Figure 2 impact test set-up

Result and Discussion

Compression Test result

Compressive Strength of Kenef /E Glass/Hemp laminate composite (3mm) combination set 1

Table 1. Compressive strength hybrid of 3mm thickness

Sample ID	Combination	Compressive Strength	Average compressive strength
A-1	EG-KE-EG	98.24	101.075
A-2	EG-KE-EG	103.91	
B-1	EG-HE-EG	108.34	111.98
B-2	EG-HE-EG	115.62	
C-1	EG-KE-HE-EG	118.02	120.93
C-2	EG-KE-HE-EG	123.84	

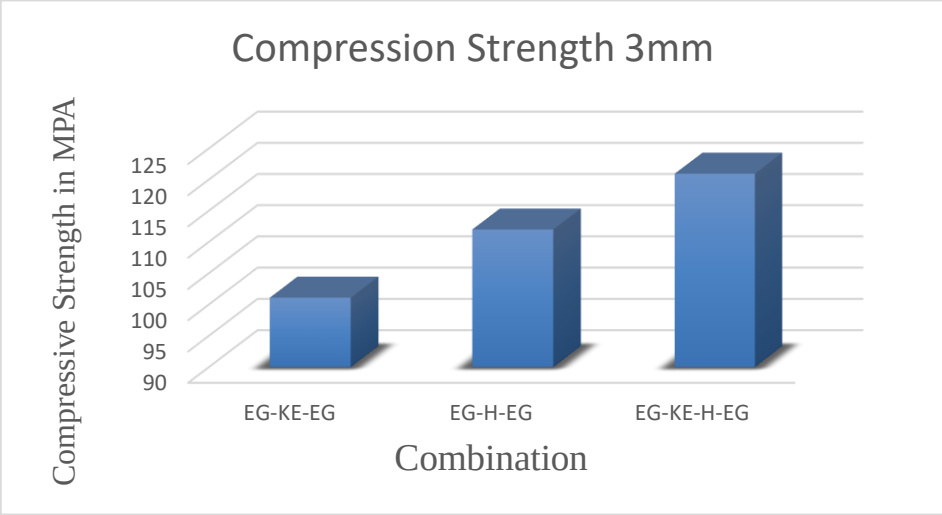

Figure 3 Compressive strength hybrid of 3mm thickness

The compressive strength of a 3mm thick Kenaf /E- Glass/Hemp laminate composite is shown in the Figure 3. In this experiment, we use two specimen trials to measure compressive strength. The maximum average compressive strength (120.93 Mpa) was achieved in the E Glass-Kenaf-Hemp -E Glass combination, and the smallest average compressive strength was achieved in the E Glass-Kenaf-E Glass combination (101.075MPa).

Compressive Strength of Kenef /E Glass/hemp laminate composite (5mm) combination set 2

Table 2 Compressive strength hybrid of 5mm thickness

Sample ID	Combination	Compressive Strength	Average compressive strength
D-1	EG-KE-EG	114.58	115.295
D-2	EG-KE-EG	116.01	
F-1	EG-HE-EG	120.67	121.645
E-2	EG-HE-EG	122.62	
F-2	EG-KE-HE-EG	130.99	130.225
F-2	EG-KE-HE-EG	129.46	

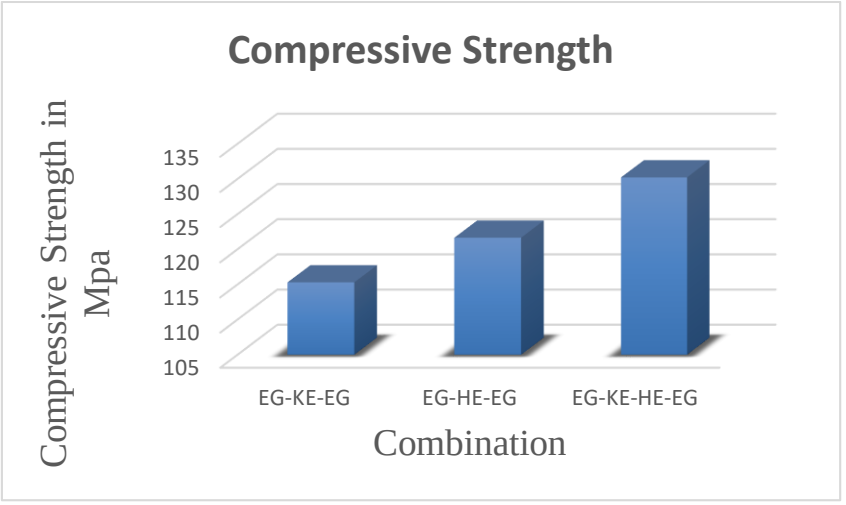

Figure 4 Compressive strength hybrid of 5mm thickness

The compressive strength of a 5mm thick Kenef/E Glass/Hemp laminate composite is shown in the figure 4. In this experiment, we use two specimen trials to measure compressive strength. The greatest average compressive strength (130.225 Mpa) was obtained in the case E Glass-Kenaf-Hemp-E Glass combination, while the minimum average compressive strength (130.225 Mpa) was obtained in the case E Glass-Kenaf-E Glass combination (115.295MPa).

Compressive Strength of Kenef /E Glass/hemp laminate composite (3mm) combination set 3

Table 3 Compressive strength hybrid of 3mm thickness (Set 3)

Sample ID	Combination	Compressive Strength	Average compressive strength
G-1	KE-EG-HE	70.27	71.155
G-2	KE-EG-HE	72.04	
H-1	HE-EG-HE	76.04	76.625
H-2	HE-EG-HE	77.21	
I-1	KE-EG-KE	82.73	83.655
I-2	KE-EG-KE	84.58	

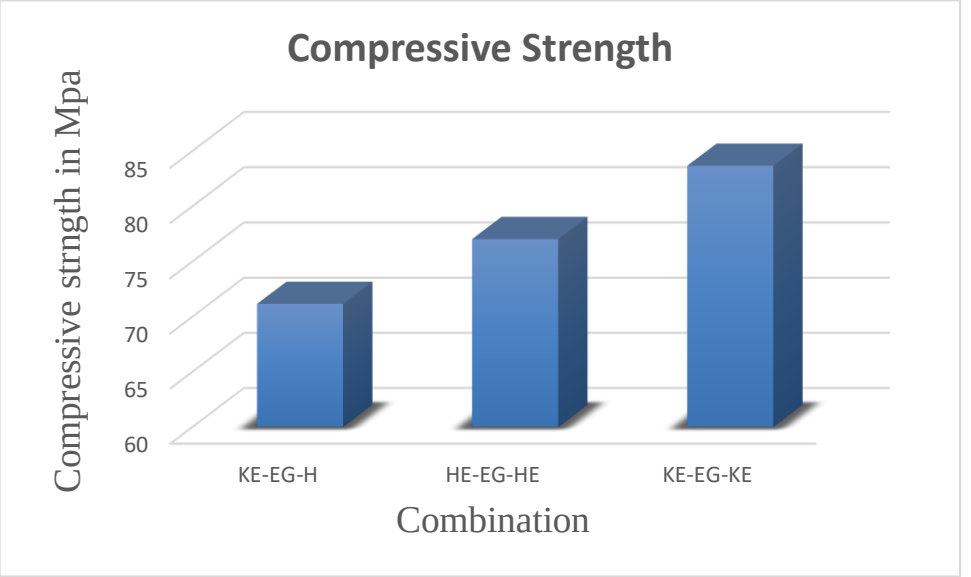

Figure 5 Compressive strength hybrid of 3mm thickness (Set 3)

The compressive strength of a 3mm thick Kenef/E Glass/Hemp laminate composite is shown in the figure 5. In this experiment, we use two specimen trials to measure compressive strength. The maximum average compressive strength (83.665 Mpa) was obtained in the case of the Kenaf-E Glass-Kenaf combination, and the smallest average compressive strength was obtained in the case of the Kenaf-E Glass-Hemp combination (71.153MPa).

II. Impact strength test result

Table 4. Impact strength of hybrid of 3mm thickness (Set 1)

Sample ID	Combination	Compressive Strength	Average compressive strength
A-1	EG-KE-EG	8	7.5
A-2	EG-KE-EG	7	
B-1	EG-HE-EG	6	6
B-2	EG-HE-EG	6	
C-1	EG-KE-HE-EG	7	7.5
C-2	EG-KE-HE-EG	8	

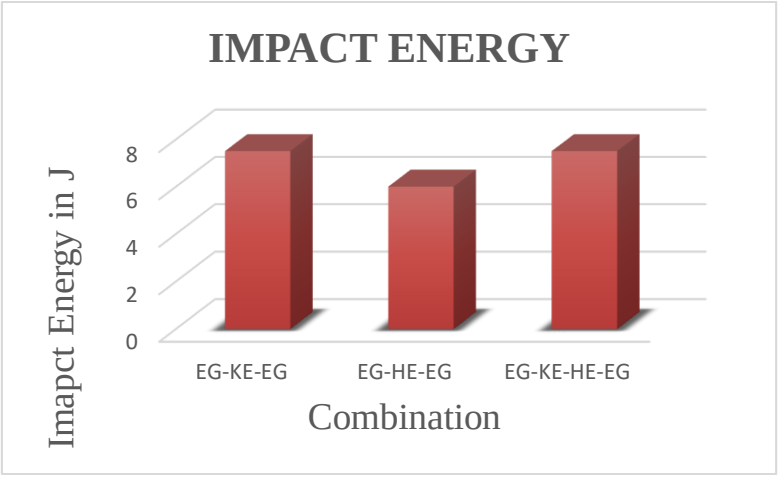

Figure 6. Impact strength of hybrid of 3mm thickness (Set 1)

The Impact Energy of a 3mm thick Kenef /E Glass/Hemp laminate composite is shown in the figure 6. In this experiment, we use two different specimens to assess the impact energy. The largest average impact energy (7.5 J) was obtained in the case of E Glass-Kenaf-E Glass and E Glass-Kenaf-Hemp-E Glass combinations, while the least average hardness number was obtained in the case of E Glass-Hemp-E Glass combinations (6 J).

Impact Energy of Kenef /E Glass/hemp laminate composite (5mm) combination set 2

Table 5. Impact strength of hybrid of 5mm thickness (Set 2)

Sample ID	Combination	Compressive Strength	Average compressive strength
D-1	EG-KE-EG	11	10.5
D-2	EG-KE-EG	10	
F-1	EG-HE-EG	8	9
E-2	EG-HE-EG	10	
F-2	EG-KE-HE-EG	9	9.5
F-2	EG-KE-HE-EG	10	

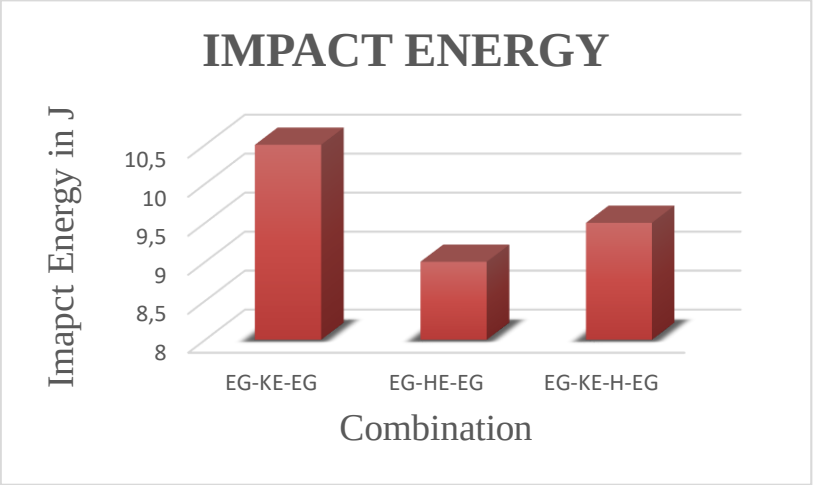

Figure 7. Impact strength of hybrid of 5mm thickness (Set 2)

The Impact Energy of a 5mm thick Kenef/E Glass/Hemp laminate composite is shown in the graph. In this experiment, we use two different specimens to assess the impact energy. The largest average impact energy (10.5 J) was obtained in the E Glass-Kenaf-E Glass combination, and the lowest average hardness number was obtained in the E Glass-Hemp-E Glass combination (9 J).

Impact Energy of Kenef /E Glass/hemp laminate composite (3mm) combination set 3

Table 6. Impact strength of hybrid of 3 mm thickness (Set 3)

Sample ID	Combination	Compressive Strength	Average compressive strength
G-1	KE-EG-HE	8	8.5
G-2	KE-EG-HE	9	
H-1	HE-EG-HE	8	9
H-2	HE-EG-HE	10	
I-1	KE-EG-KE	8	7.5
I-2	KE-EG-KE	7	

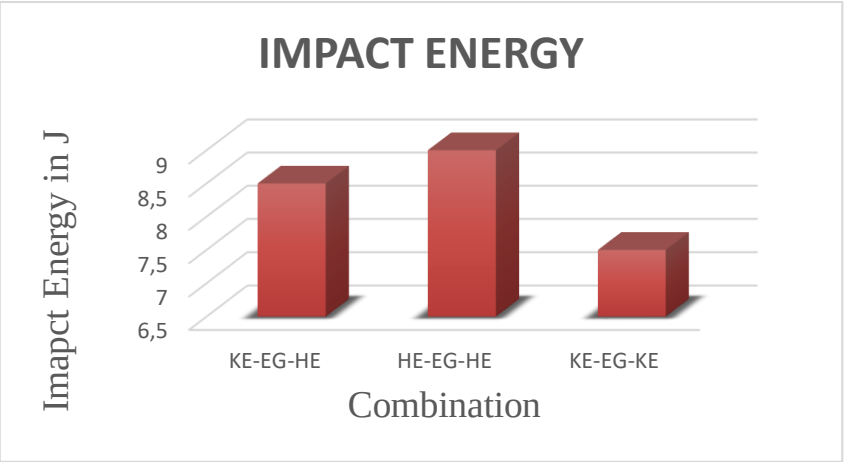

Figure 8. Impact strength of hybrid of 3 mm thickness (Set 3)

The Impact Energy of a 3mm thick Kenef/E Glass/Hemp laminate composite is shown in the Figure 8. In this experiment, we use two different specimens to assess the impact energy. The largest average impact energy (9 J) was obtained in the case of Hemp-E Glass-Hemp combination, and the lowest average hardness number was obtained in the case of Kenaf-E Glass-Hemp combination (7.5 J).

Conclusion

The conclusions drawn from this study of Kenef /E Glass/hemp composite laminates are as follows. When the combination of E-glass/Kenaf/Hemp/E-glass is 130.225 Mpa in 5 mm thickness, the Compression Strength of hybrid composites is higher. (STAGE 2). It has been discovered that when the combination of E-glass/Kenaf/E-glass is 10.5 in 5 mm thickness, the Impact Energy of hybrid composites is higher. (STAGE 2)

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