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Mechanical Characterization of Hybrid Hemp/Glass Fiber Reinforced Epoxy Composite

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***Abstract*: From the last three decade the use of composite material, plastic and ceramics are replaces the other material. The application of the composite material grown steadily and which occupied the new market. In our daily life use of the composite material in different field because of their combinational properties which include high resistance to thermal expansion. The main reason for using the composite is to reduce the weight. The environmental issues have recently generated considerable interest in development of recyclable and biodegradable composite materials. Therefore, research in the field of using Natural fibers has attracted much attention in the material science and engineering discipline. Natural fiber is certainly a renewable resource that can be grown and made within a short period of time. In present investigation hybrid composite is developed using Hemp/E-glass as reinforcing material and Epoxy as a matrix material. To sustain the environmental condition and water absorption, E-glass fiber is used. The fabrication is done using hand lay-up technique. The developed hybrid composite will be subjected to different kind of test to determine mechanical properties. The result shows that the hybrid composite with a composition of 40% HF and 30% GF has good tensile property to other hybrid composite at 0° fiber orientation. For 30° fiber orientation hybrid composite with a composition of 50% HF and 20% GF has good flexural & impact property to other hybrid composite.**

***Keywords:* Natural fibers, Hemp fiber, E-Glass fiber, Hand lay-up method, Tensile, Flexural, Impact.**

I. INTRODUCTION

In our daily life use of the composite material in different field because of their combinational properties which include high resistance to thermal expansion. The main reason for using the composite is to reduce the weight. The environmental issues have recently generated considerable interest in development of recyclable and biodegradable composite materials. Therefore, research in the field of using Natural fibers has attracted much attention in the material science and engineering discipline. Natural fiber is certainly a renewable resource that can be grown and made within a short period of time. In present investigation hybrid composite is developed using Hemp/E-glass as reinforcing material and Epoxy as a matrix material. To sustain the environmental condition and water absorption, E-glass fiber is used.

II. OBJECTIVE

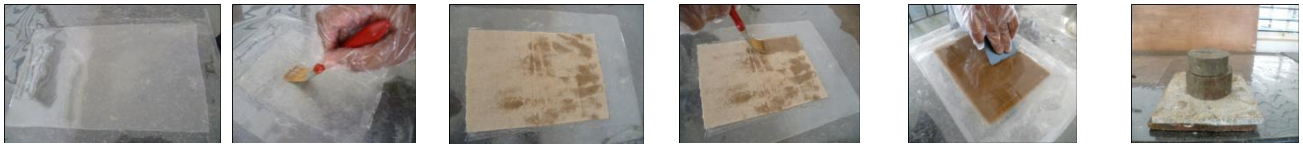
The main objective of this work is to fabricate Natural – Polymer hybrid composite using Hemp fiber& E-glass fiber (300 GSM) as reinforcement & matrix material as epoxy resin by hand lay-up method and to characterize the mechanical properties of Natural – Polymer hybrid composites.

III. MATERIAL

Hemp plant is genus Cannabis (family Cannabaceae) that is cultivated for its fiber (bast fiber) or its seeds. Hemp fibers can be used to produce strong, durable, and environmental friendly plastic substitutes. Thousands of products can be made produce from hemp based composite.Fiber glass or glass fiber are material made from extremely fine fibers of glass. The typical composition of E-Glass (300 GSM) fabric, it consists of silicon Dioxide 52-56%, Calcium Oxide 16-25% Aluminium Oxide 12-16%, Boron Oxide 8-13%, Sodium & Potassium Oxide 0-1% and Magnesium Oxide 0-6%. Lapox L-12 epoxy with hardener K-6 is used as a matrix material.

IV. FABRICATION

Composite laminates were fabricated at room temperature in shape of square plates by hand layup technique. Proper care was taken during fabrication of laminates to ensure uniform thickness and minimum voids in the material. The laminates were fabricated by placing the reinforcement material one over the other with a matrix in between the layers. Tools were used to distribute resin uniformly, compact plies and to remove entrapped air. The surface of the composite laminate was covered with releasing sheet film to prevent the layup form external disturbances. The laminates were cured in room temperature and constant pressure for 24 hours. The laminated test specimens were prepared by a wire cutting machine to suit ASTM dimension.



Affixation of release film onslabs forming mold | **Application of first resin coat** | **Placement of fabric** | **Application of resin on fabric** | **Placing release film over lay-up** | **Curing stage**

Fig.1: Fabrication procedure

V. TESTING

1. Tensile Test:

Tensile Test was carried out on a computerized UTM according to ASTM D-638. The specimen length of 150 mm with a width of 20 mm was prepared for this study, shown in Figure2.

Fig.2: Tensile Test Specimens

2. Flexural Test:

According to ASTM D-790, flexural testing has been carried out. The specimen length of 80 mm with a width of 210 mm was prepared for this study, shown in Figure 3.

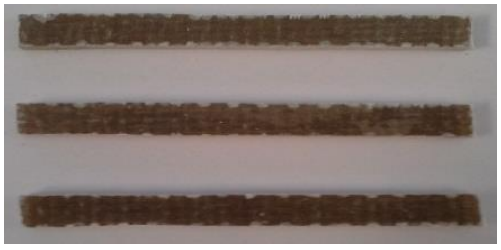


Fig.3: Flexural Test Specimens

3. Impact Test:

According to ASTM D 792, the impact test specimens were prepared for impact test having the dimension of 10 mm width, length 80 mm. The test specimen is shown in figure 4.

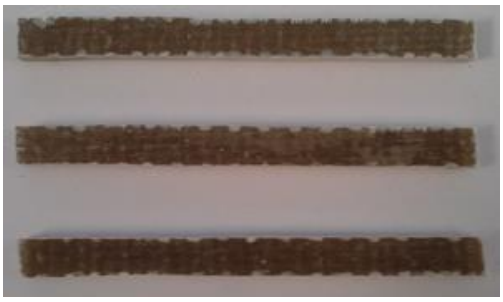


Fig.4: Impact Test Specimens

VI. RESULTS AND DISCUSSION

1. Tensile Test Results:

Table 1: Tensile test results

Material	Orientation	Ultimate Tensile Strength (MPa)
Pure Hemp	0°	28.6
	30°	25.31
	45°	21.58
Hybrid (GF 30% & HF 40%)	0°	62.69
Hybrid (GF 20% & HF 50%)	0°	56. 6
	30°	54. 05
	45°	50. 031

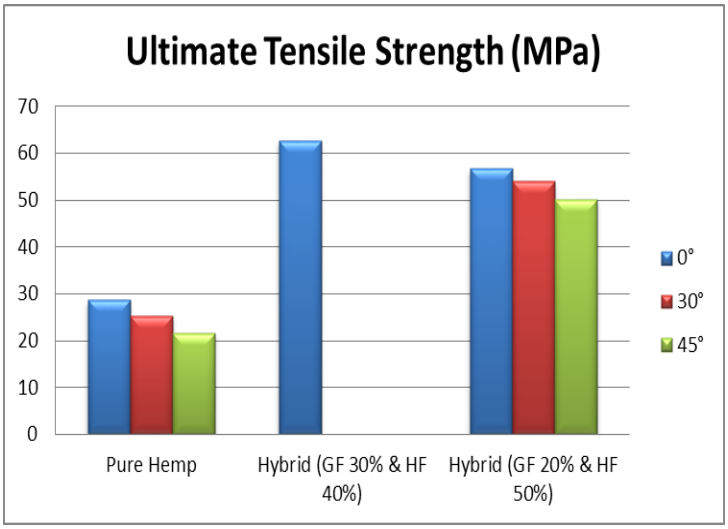


Fig 5: Comparison of ultimate tensile strength of different composition and orientation of hybrid composite.

The results obtained from the tensile test conducted on pure hemp for 0°, 30° and 45° orientation and hemp/e-glass hybrid composite for different composition and orientation are as shown in table 1. Figure 5 shows the overall comparison of tensile strength of different composition and orientation of hybrid composite and also shows that tensile strength of hybrid composite at 0° fiber orientation & with composition of 40% hemp and 30% E-glass has more strength compared to pure hemp composite and hybrid composite with composition of 50% hemp & 20% E-glass

2. Flexuraltest Results:

Table 2: Flexural test results

Material	Orientation	Flexural Strength (MPa)
Pure Hemp	0°	23.61
	30°	35.19
	45°	33.54
Hybrid (GF 30% & HF 40%)	0°	120.54
Hybrid (GF 20% & HF 50%)	0°	122.24
	30°	138.78
	45°	124.08

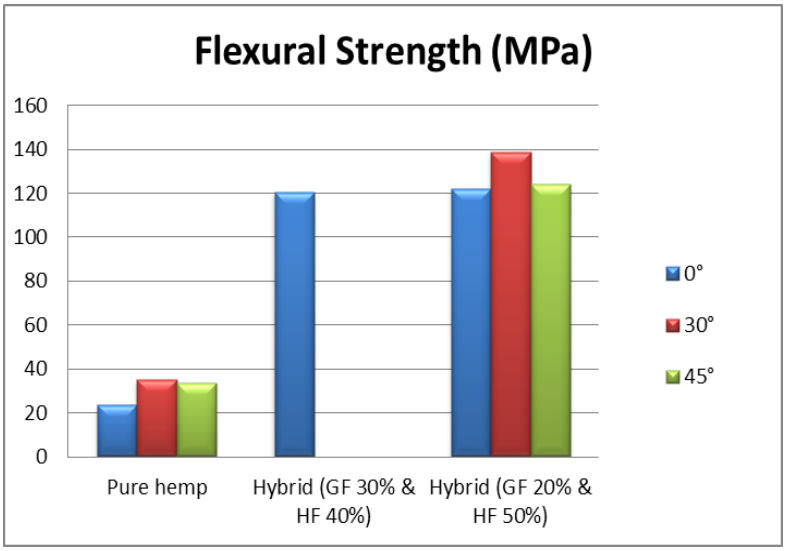


Fig 6: Comparison of flexural strength of different composition and orientation of hybrid composite.

The results obtained from the flexural test are shown in table 2. Fig 6 shows that flexural strength of hybrid composite at 30° fiber orientation & with composition of 50% hemp and 20% E-glass has more flexural strength compared to 0° & 45° orientation, and also more compared to pure hemp composite at 0°, 30° & 45° fiber orientation and hybrid composite with composition of 40% hemp & 30% E-glass at 0° fiber orientation.

3. Impact Test Result:

Table 3: Impact test results

Material	Orientation	Impact Strength (kJ/m²)
Pure Hemp	0°	8
	30°	15
	45°	10
Hybrid (GF 30% & HF 40%)	0°	45
Hybrid (GF 20% & HF 50%)	0°	42
	30°	63
	45°	53

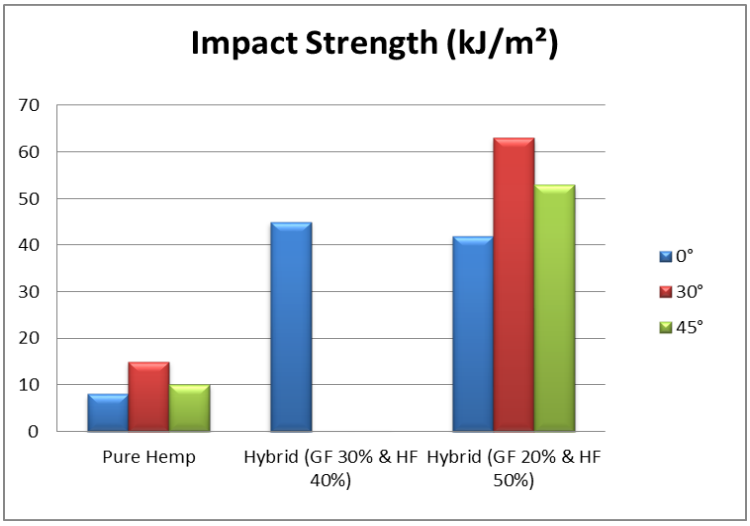


Fig 7: Comparison of impact strength of different composition and orientation of hybrid composite.

The results obtained from the impact test are shown in table 3. Fig 7 shows the overall comparison of impact strength of different composition and different orientation of hybrid composite. The impact strength of Hybrid composite at 30° fiber orientation & with composition of 50% hemp and 20% E-glass has more impact strength compared to 0° & 45° orientation, and also more compared to pure hemp composite at 0°, 30° & 45° fiber orientation and hybrid composite with composition of 40% hemp & 30% E-glass at 0° fiber orientation.

VII. CONCLUSION

The natural hybrid composite is developed by using hand lay-up technique. The hybrid composite, using Hemp fiber, E-Glass and epoxy resin is developed for 0°, 30° and 45° fiber orientations. The specimens are prepared according to ASTM standards. The effect of combination of fibers is investigated. From the discussion of the results obtained the conclusion is made as follows.

1. The tensile strength of hybrid composite at 0° fiber orientation & with composition of 40% hemp and 30% E-glass has more strength compared to pure hemp composite and hybrid composite with composition of 50% hemp & 20% E-glass.
2. The flexural property is high at 30° fiber orientation.
3. The impact strength for 30° fiber orientation is found to be high compared to other.

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