

## Procedural Fabrication and Characterization of Hemp Fiber Reinforced Polymer Composite

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**Abstract:** The need for this fabrication and study is to increase the life and be a very good cost effective material for many applications, that to mainly in automobile and various home appliances. The reasons for the application of natural fiber in the automobile INDUSTRY are due to their low density, acceptable mechanical properties, low wear, favorable eco balance and less weight. So, these natural fibers are used in various body parts of an automobile.

**Key words:** Component • Matrix composite • Natural fiber • Vinyl ester resin

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### INTRODUCTION

All Composite materials can be classified into three groups on the basis of matrix material.

#### They Are:

- Metal Matrix Composites (MMC)
- Ceramic Matrix Composites (CMC)
- Polymer Matrix Composites (PMC)

#### Two Types of Polymer Composites Are:

- Fiber reinforced polymer (FRP)
- Particle reinforced polymer (PRP)

**Fiber Reinforced Polymer (FRP):** Fiber reinforced composite are composed of fiber and a matrix. Fiber is the reinforcement and the main source of strength, the fiber together in shape and transfer stress between the reinforcing fiber[1]. The fiber carry the loads along their longitudinal direction. Sometimes, filler might be added to smooth the manufacturing process, impact special property to the composite and or reduce the product cost.

**Natural Fiber:** Natural fiber used as a alternate for glass, motivated by potential advantages of lower raw material price, weight saving and thermal recycling or the ecological advantages of using resources which are renewable[2]. Natural fiber have lower-durability and lower strength than glass fiber.

### Methodology

#### Sequential Steps:

- The reinforcement material is natural fiber and matrix material used here is vinyl ester resin(Synthetic resin).
- The main objective is to fabricate reinforced[3] composite polymer of natural fiber(hemp) follows,
- Fabrication of fiber plate by hand-lay method.
- Conversion of Fiber plate into composite plate.
- The mechanical test to be done here is tensile strength, flexural strength and impact strength.

#### Raw Material:

- Natural fiber (hemp)
- Vinyl ester resin

**Hemp Fiber:** Hemp is a commonly used term for high-growing varieties of the Cannabis plant and its products, which include fiber, oil and seed. Hemp is refined into products such as hemp seed foods, hemp oil, wax, resin, rope, cloth, pulp, paper and fuel.

#### Vinylester Resin (Synthetic Resin):

- ▶ Vinyl Ester, or Vinyl ester, is a resin produced by the etherification of an epoxy resin with an unsaturated monocarboxylic acid.
- ▶ Vinyl ester has lower resin viscosity (approx. 200 cps) than polyester (approx 500cps) and epoxy (approx 900cps).

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- ▶ It has more strength and mechanical properties than polyester and epoxy resin.

**Resin Compositon:** Following promoter, accelerator and catalyst is added with resin

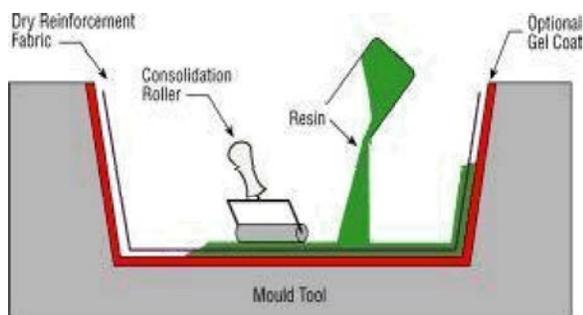
- 1 kg of vinyl ester resin is added with 15ml promoter.
- 1 kg of vinyl ester resin is added with 15ml accelerator.
- 1 kg of vinyl ester resin is added with 15ml catalyst.
- Vinyl Ester, or Vinyl ester, is a resin produced by the etherification of an epoxy resin with an unsaturated monocarboxylic acid.
- Vinyl ester has lower resin viscosity (approx. 200 cps) than polyester (approx 500cps) and epoxy (approx 900cps).
- It has more strength and mechanical properties than polyester and epoxy resin.

**Working Method**

**Hand Layup Method:**

- ▶The fiber piles were cut to size from the fiber cloth, The appropriate numbers of fiber plies were taken: three for each.
- ▶ Then the fiber were weighed and accordingly the resin and hardeners were weighed, Vinyl ester and hardener were mixed by using glass rod in a bowl.
- ▶ Care was taken to avoid formation of bubbles, because they may result failure in the material, the fabrication process consisted of first putting a releasing film on the mould surface.

Next a polymer coating was applied on the sheets, then fiber ply of one kind was put and proper rolling was done[4], Then resin was again applied. in the paper. Do not number text heads the template will do that for you.



**Fabrication of Composite Plate**

- Hand layup method is performed were the waxing is done on the mould to remove the plate easily after it gets dried.
- The amount of resin is spread on the mould and first layer of *hemp fiber* is kept and resin is poured and spreader on the fiber evenly. Next fiber layer is kept and resin is spreader evenly.



**Result Analysis**

**Scanning Electron Microscope (SEM):** To identify the mode of material removal, the morphologies of eroded surfaces are observed under scanning electron microscope.[5] Figure shows the local removal of resin material from the impacted surface resulting in exposure of the fiber to the erodent flux.

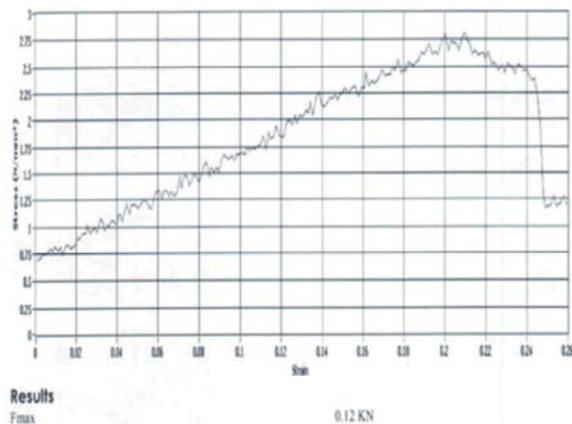
Following are the test done on composite:

- ▶ Impact test (Izod)
- ▶ Tensile test
- ▶ Flexural test
- ▶ SEM images
- ▶ ASTM standard for tensile test
- ▶ Specimen size: 250 mm x 25 mm x 2.5 mm
- ▶ ASTM standard for flexural test
- ▶ Specimen size: 127mm x 12.7mm x 3mm
- ▶ ASTM standard for impact test (IZOD)
- ▶ Specimen size: 63.5mm x 12.7mm x 3.2 mm

TABULATION ON STRENGTH

STRENGTHS	HEMP
Impact strength (Kgm)	0.15
Tensile strength (N/mm <sup>2</sup> )	16.42
Flexural strength (KN)	0.12

### Flexural Strength Graph of Hemp Fiber

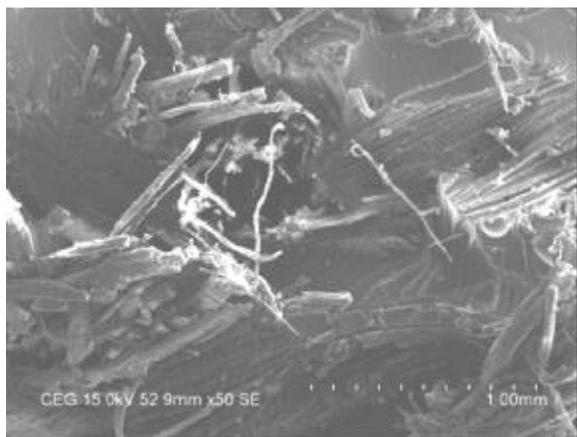


**Tensile Strength Comparison:** From tensile strength graph of hemp fiber, it possess more tensile strength. usually the bast type of fiber has more tensile strength because of pretreatment properties. the flexural properties is lighter than remaining fiber composite

**Flexural Strength Comparison:** From flexural strength graph of HEMP fiber, it possess more flexural strength. Usually the bast type of fiber has more flexural strength too because of pretreatment properties.

**Impact Strength Comparison:** The impact resistance of HEMP FIBER is high and it sustain a good flexural properties too.

### Structural Image of Hemp



### CONCLUSION

- ▶ This work shows that successful fabrication of fiber reinforced vinyl ester composite with hemp fiber is possible by simple hand lay-up technique.
- ▶ It has been noticed that the mechanical properties of the composite such as tensile strength, flexural strength, impact strength etc. of the composite is also greatly influenced by the fiber.
- ▶ The fracture surfaces study of fiber reinforced vinyl ester composite after the tensile test, flexural test and impact test has been done.
- ▶ From this study it has been concluded that the mechanical properties of this fiber is good, which has been used for analysis

### REFERENCES

1. Mwaikambo, L.Y. and M.P. Ansell, 2002. Chemical modification of hemp, sisal, jute and kapok fibers by alkalis. *J Appl Polym Sci.*, 84(12): 2222-34.
2. Bhuwan M. Prasad & Mohini M. Sain, 2005. Structure Property Correlation of Thermal Treated Hemp Fiber, DOI: 10.1002/mame.200300276, 289(6): 581-592.
3. Sridhar, M.K., G. Basavarajappa, S.G. Kasturi and N. Balasubramanian, 1982. Evaluation of Jute as a Reinforcement in Composites, pp: 87-92.
4. Gonzalez, C. and G.E. Myers, 1993. Thermal degradation, fillers at the melt *International Journal of Polymeric Materials*, 23(1-2): 67-85.
5. Wielage, B., Th. Lampke, H. Utschick and F. Soergel, 2003. *J. Material Processing. Technology*, 139: 140.