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# An Experimental Study of Mechanical Properties of GFRP Hybrid Composite with Different Fillers

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## Abstract

*This paper presents the recent trends in the mechanical characterization of composite materials with different fillers materials to make it a hybrid composite. First, The different types of composites are fabricated by hand lay-up method, using 10% wt filler material with 50%wt glass fiber, rest polyster resin as matrix material. Hematite ore and chicken feathers are used as filler materials. Next, Specimens were cut and tested according to ASTM standards. The mechanical properties were studied viz:, tensile strength and bending strength of the material. Last, the results were compared for different filler material.*

## Keywords—

GFRP; Mechanical Properties; Unsaturated polyester resin; Hematite ore; Chicken Feather filler.

## I. Introduction

The composite materials are made up of reinforcement and matrix materials. Fillers are introduced to reduce the cost of composite without affecting its basic properties. The mechanical properties of filled hybrid composites depend mainly on size, shape, distribution and volume fraction of filler in the hybrid composite.

At present, polyster resins are widely used in various engineering and structural applications. In order to reduce cost of materials used, with improve in their processing and product performances, various fillers are added into the resins during processing. Thoughhybrid composites are susceptible to mechanical damage, when subjected to tension, compression, and flexural loads resulting in interlayer delamination/debonding.Use of low cost easily available fillers may be useful to bring the cost of component down.Over the past several decades an enormous efforts have been made to study the mechanical characteristics of composites.

Works are reported mainly enhancing the properties by using the different types of fillers, Manojmingla and vikaschawlarepotred that increase in content of fly ash increases the compressive strength and decreases the impct strength of the composite. Vithal Rao Chauhan et.al., worked on the mechanical properties of glass/orthophthalicpolyster resin with hematite ore filled composites and observed that the inclusion of hematite ore in composites with increased tensile strength and flexural strength. Increase filler percentage till 6% weight fraction in composites got beneficial mechanical properties, further increase of filler material with matrix material improper bonding, interface and embrittlement of the composites causes detrimental effect.

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V. Ananda Rao, AlokSatapathy, S.C. Mishra were worked on the Polymer composites reinforced with short fibers obtained from poultry feathers based on the erosion characteristics and gave a result. ManjunathShettar et.al., quoted that, most of poultry waste is disposed through traditional method viz., burning,burring or contaminating the grounds. So it can be utilized and used in the engineering applications for the lower cost and superior characteristics. Also concluded that the reinforcement material have potential due to impact behavior. The tensile and bending strength can be improved with increase in feather percentage.

Hence by this paper presents, experimental investigation on the effect of the different fillers used glass /unsaturated polyester resin hybrid composite. The objective is to investigate the tensile strength and bending strength of the material.

## II. Materials Used

E-glass fabric of plain weave construction was used for the Unsaturated polyesters resin matrix with hardener N and accelerator N were used. The filler is mixed with resin depending upon percentage. The details about material combination and percentage of filler used are given in table (1) below.

**Table 1: Details of specimens prepared**

| Matrix | Vol (%) | Reinforcement | Vol (%) | Filler | Vol (%) |
|---|---|---|---|---|---|
| Unsaturated polyesters | 50 | Glass fiber | 50 | No Filler | 00 |
| Unsaturated polyesters | 40 | Glass fiber | 50 | Hematite ore | 10 |
| Unsaturated polyesters | 40 | Glass fiber | 50 | Chicken Feather | 10 |

## III. Experimentation and Result Discussion

### Tensile Test

Tensile test was performed in accordance with ASTM D3039, using an UTM.Test specimen were well filed to attain overall length and gauge length of 250 and 140mm respectively as shown in Figure 1

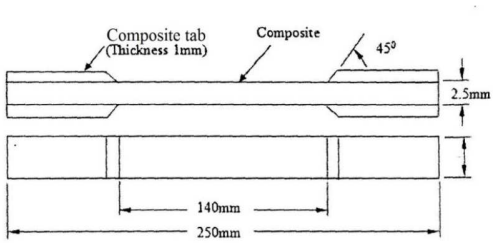


**Figure: 1 Tensile Test Specimen**

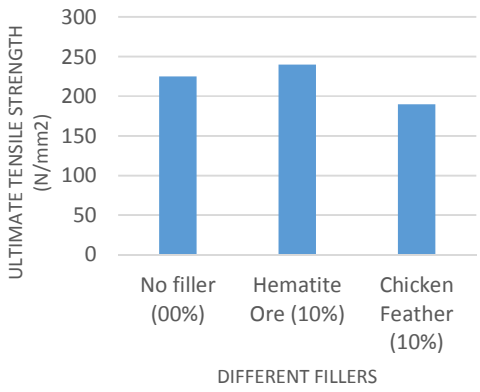


**Figure: 2 The comparison of UTS of different filler material**

The three specimens of each sample of composite were subjected to tensile test and mean value is considered for comparison.The result gives a brief outline on ultimate tensile strength of the 10% filler added to the resin material and Glass fiber. There isincrease in tensile strength of the hematite ore filled composite, but decrease in chicken feather filled composite, compared to no-filler composite. Chicken feather filler shows the decrease in tensile strength due to weak bonding between the filler and the resin material. The figure 2 show the overview of test.

### Three-Point Flexural Bending Test

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3-point bending test was performed in accordance with ASTM D 790, using an UTM.The width and length of the specimen was 12.7mm and 127mm as shown in Figure 3

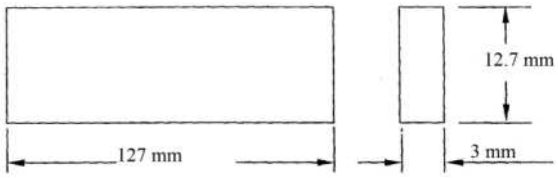


**Figure: 3 Three-Point Flexural Bending Test Specimen**

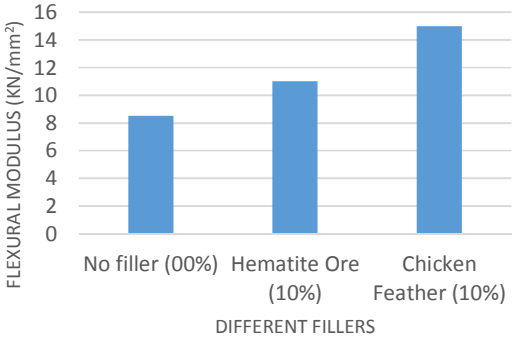


**Figure: 4 The comparison of Flexural Strength of different filler material**

The three specimens of each sample of composite were subjected to 3 point bending test and mean value is considered for comparison.The result gives a brief outline on flexural bending test of the 10% filler added to the resin material and Glass fiber. There is increase in flexural strength of both type composite, compared to no-filler composite. Chicken feather filler shows the increaseinbending strength,this might be due to as the percentage of filler increases ductility of the material increases. The figure 4 show the overview of test.

## IV. Conclusion

First, the fabrication of hybrid reinforced polymer composites were carried out by hand layup method. Next, the experimental investigations on the composite specimens were carried out to determine the tensile strength and flexural strength. Hematite ore filled composite shows better tensile strength and chicken feather filled composite shows the better flexural strength, than the unfilled composite. Hence, it proves that depend up on the requirement of properties of composite, the different fillers can be used. Last, the use of filler materials reduced the production cost of composite.

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