Analysis of Mechanical Properties of Mill Glass Fibre and Vinyl Ester Composite Material

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Abstract— In this work investigation of experimental study of mill glass fiber reinforced vinyl ester composite was Carrie. Composite laminates is prepared by mixing mill glass fiber and vinyl ester with proper curing agents. This was placed on the matched plate mould and pressed at 1500PSI for 1 hour at 8000C temperature. The mill glass fiber reinforced vinyl ester composites were manufactured at various ratios such as (35:65, 40:60, 45:55 & 50:50). The mechanical properties of mill glass fiber reinforced vinyl ester composites like tensile strength, flexural strength, and impact strength and water absorption capacity has been test and analyzed. Tensile and flexural tests showed that mill glass fiber cloth composites withstand more load than other composites.

Key words: Mechanical Properties, Mill Glass Fibre, Vinyl Ester

I. INTRODUCTION

The natural fibers selected for the making of composites are Glass fiber (mill cloth) Glass-reinforced plastic (GRP) is a composite material or fiber-reinforced plastic made of a plastic reinforced by fine glass fibers. Like graphite-reinforced plastic, the composite material is commonly referred to as fiber glass. The glass has been in the form of a chopped strand mat (CSM) or a woven fabric. As with many other composite materials (such as reinforced concrete), the two materials act together, each overcoming the deficits of the other. Whereas the plastic resins are strong in compressive loading and relatively weak in tensile strength, the glass fibers are very strong in tension but tend not to resist compression. By combining the two materials, GRP becomes a material that resists both compressive and tensile forces well. The two materials may used uniformly or the glass may specifically placed in those portions of the structure that will experience tensile loads.

A. Uses

Uses for regular glass fiber include mats and fabrics for thermal insulation, electrical insulation, sound insulation, high-strength fabrics or heat and corrosion-resistant fabrics. It is also used to reinforce various materials such as tent poles, Pole vault poles, arrows, bows and crossbows, translucent roofing panels, automobile bodies, hockey sticks, surfboards, boat hulls, and paper honeycomb. It had been use for medical purposes in casts. Glass fiber is extensively used for making FRP tanks and vessels. Open-weave glass fiber grids is use to reinforce asphalt pavement. Non-woven glass fiber/polymer blend mats are use saturated with asphalt emulsion and overlaid with asphalt, producing a waterproof, crack-resistant membrane. Use of glass-fiber reinforced polymer rubber instead of steel rubber shows promise in areas where avoidance of steel corrosion is desire.

B. Selection of Matrix

1) Vinyl ester Resin

a) Vinyl ester

A type of polymer used in engineering composite resins. Vinyl esters have mechanical properties that are between those of polyester and epoxies.

Vinyl ester combines inherent toughness with outstanding heat and chemical resistance Corrosion-resistance.

Possesses low ester content and low unsaturation resulting in greater resistance to hydrolysis and less shrinkage during cure.

Within a mould, the reinforcing and matrix materials is combine, compacted, and cured (processed) to undergo a melding event. After the melding event, the part shape is essentially set, although it can deform under certain process conditions. For a thermostats polymeric matrix material, the melding event is a curing reaction that is initiated by the application of additional heat or chemical reactivity such as organic peroxide. For a thermoplastic polymeric matrix material, the melding event is solidification from the melted state. For a metal matrix material such as titanium foil, the melding event is a fusing at high pressure and a temperature near the melting point.

II. EXPERIMENTAL INVESTIGATION

A. Making of Specimen

The fabricated composite materials are prepared for testing as per the ASTM standards. The various mechanical tests and specimen sizes are listed below.

Test	Standard	Specimen size
Tensile Test	ASTM D 3039	250mm x 25mm x 3mm
Flexural Test	ASTM D 790	125mm x 13mm x 3mm
Impact Test	ASTM D 256	65mm x 13mm x 3mm
Water Absorption Test	ASTM D 570	20mm x 20mm x 3mm

Table 1: Various Mechanical tests and their specimen sizes

Specimen No.	Ratio of fiber & resin	Weight in grams	Resin	Temp in 0C
01	35:65	400	V+P+A+C	80
02	40:60	400	V+P+A+C	80
03	45:55	400	V+P+A+C	80
04	50:50	400	V+P+A+C	80

Table 2: Mechanical tests and their specimen sizes

The combination of vinyl ester (V), promoter (P), Accelerator (A), and Catalyst(C) are the resins. One of the fiber & resin weight ratios is 35: 65 First, fiber weighted for 35 % and it found to be 140 Gms. Second the resin system weight for 65 % weight fraction and it found to been 260 gms Vinyl ester=252.95 gms, promoter = 2.35 gms, Accelerator=2.35 gms, Catalyst= 2.35 gms, Total =260 gms as the total weight of composite is 400 gms.

percentages	No. of sheet	gms
1 %	1 sheet	15.55 gms
35 %	9 sheets	139.95 gms
40 %	10 sheets	155.5 gms
45 %	11 sheets	171.05 gms
50 %	12 sheets	186.6 gms

Table 3: Result

B. *Fabricated Composite Material*

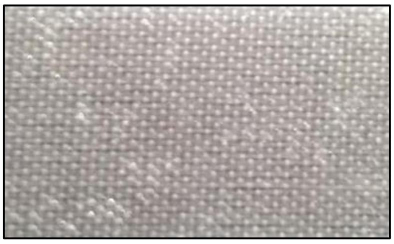


Fig. 1: Weight ratio 35:65

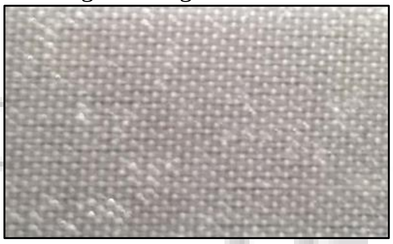


Fig. 2: Weight ratio 40:60

Fig. 3: Weight ratio 45:55

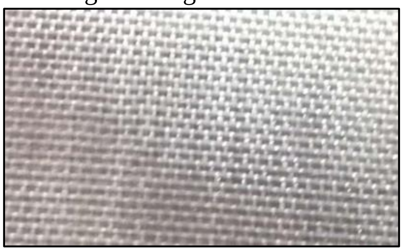


Fig. 4: Weight ratio 50:50

III. RESULTS AND DISCUSSION

A. *Tensile Test Result*

Tensile testing of specimen prepared according to ASTM D 3039, using electronic tensile testing machine with cross head speed of 2 mm/min and a gauge length of 150 mm. The tensile modulus and elongation at the break of the composites were calculated from the stress strain curve. Three specimens were tested for each set of samples and the mean values were reported. The first samples gave good results when compared with the other samples.

Fig. 5: Tensile test specimen before testing

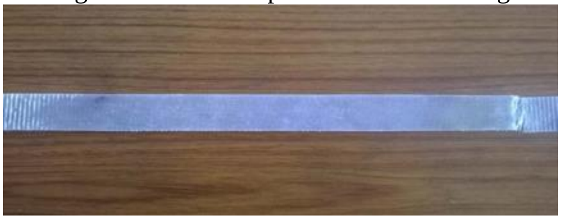


Fig. 6: Tensile test specimen after testing

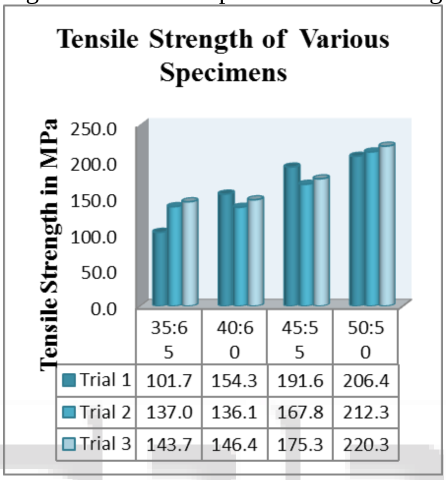


Fig. 7: Tensile strength comparisons of Mill Glass Fiber and Vinyl Ester composite samples

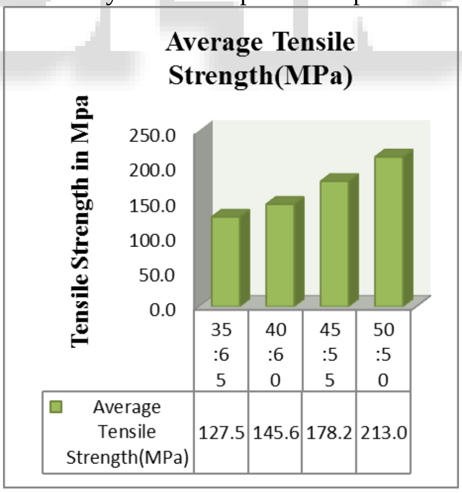


Fig. 8: Comparisons of average tensile strength Mill Glass Fiber and Vinyl Ester composite samples

B. *Flexural Test Result*

The flexural test was performed by the three points bending method according to ASTM D 790, and cross head speed of 2 mm/min. Three specimens were tested, and the average was calculated. The specimen was freely supported by a beam, the maximum load was applied in the middle of the specimen, and the flexural modulus is calculated from the slope of the initial portion of the load deflection curve. The first samples gave good results when compared with the other samples. The tested results are given below.

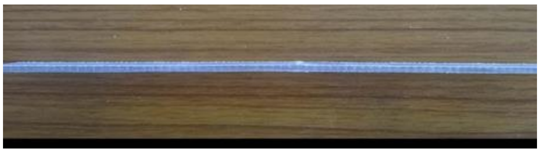


Fig. 9: Flexural test specimen before testing

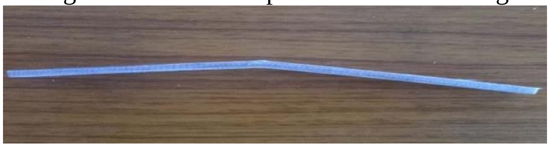


Fig. 10: Flexural test specimen after testing

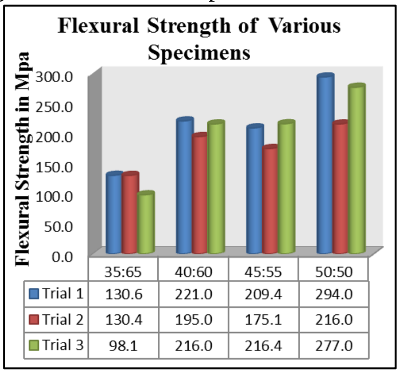


Fig. 11: Flexural strength comparisons of Glass Fiber and Vinyl Ester composite samples

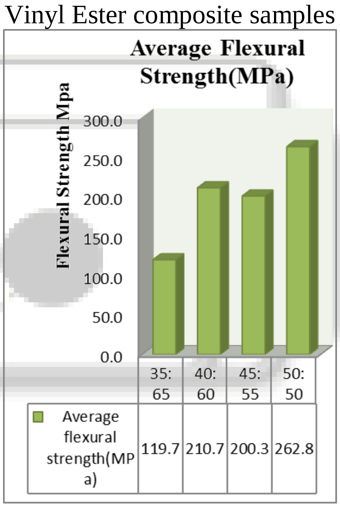


Fig. 12: Comparisons of average flexural strength Glass Fiber and Vinyl Ester composite samples

C. Impact Test Result

For analyzing the sudden load carrying capacity of the Glass fibre&Vinyl ester reinforced composite samples an impact test is carried out. The impact test was performed according to ASTM D 256.The specimen is clamped into the pendulum impact test fixture with the notched side facing the striking edge of the pendulum. The pendulum is released and allowed to strike through the specimen. The tested results are given below.

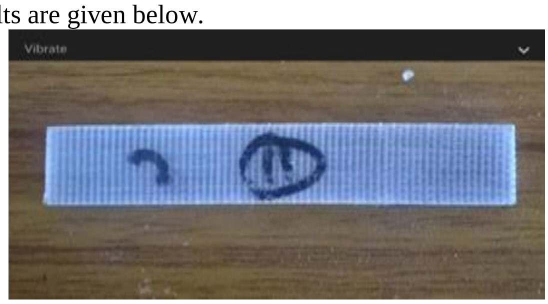


Fig. 13: Impact test specimen before testing

Fig. 14: Impact test specimen after testing

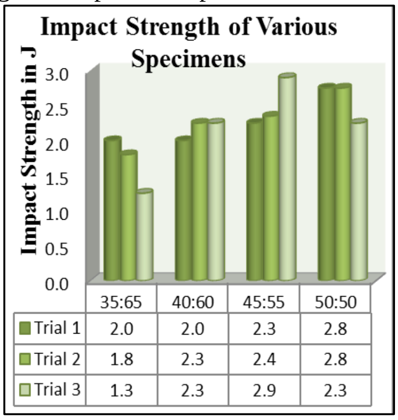


Fig. 15: Impact strength comparisons of Glass Fiber and Vinyl Ester composite samples

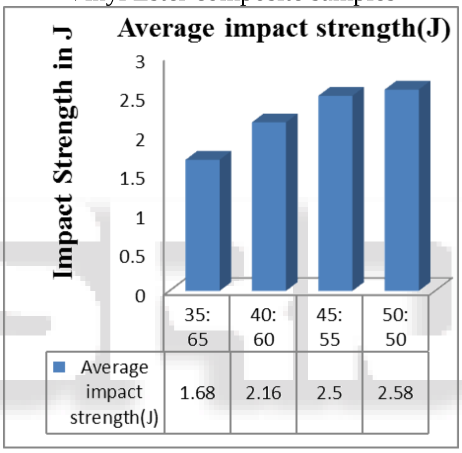


Fig. 16: Comparisons of Average Impact Strength of Glass Fiber and Vinyl Ester composite samples

D. Water Absorption Test Result

Analyzing the water carrying capacity of the Glass fibre&Vinyl ester reinforced composite samples an impact test is carried out. The water absorption test was performed according to ASTM D 570.The specimen dumped into the glass of water, the absorption test doing in 24 hrs .The tested results are given below.

Fig. 17: water absorption test specimen before testing

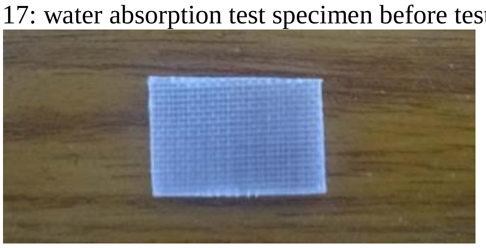
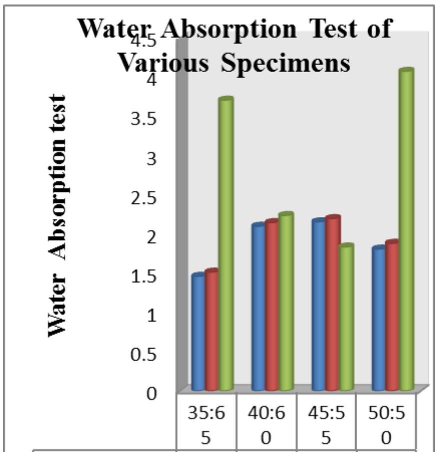


Fig. 18: Water absorption test specimen after testing



	35:65	40:60	45:55	50:50
Weight before test in gms	1.46	2.10	2.15	1.81
Weight after test in gms(24 hrs)	1.513	2.14	2.19	1.88
% of water absorption	3.7	2.23	1.83	4.07

Fig. 19: Water absorption test specimen testing

IV. Conclusion

The Mechanical behaviour of glass fibre cloth and reinforced vinylester composites was studied. From the close results obtained for vinylester composites with fibre & resin ratio 50:50, vinylester, accelerator, Promoter, catalyst, and MIL GLASS FIBER CLOTH fibres, it can be concluded that shortest ratio fibres have good adhesion with the vinyl ester resin for tensile properties. In addition, the composite with glass fibre cloth exhibited a same ratio good adhesion with higher flexural strength and then shear strength also good adhesion of the glass fibre cloth. It can be concluded that MIL GLASS FIBER CLOTH fibres is necessary to get composites with moderate mechanical properties as well as better adhesion between fibres and matrix.

References

[1] J. G. Iglesias, J. Gonz´alez-Benito, A. J. Aznar, J. Bravo, Recent development of glass fibres and different polymeric matrices
[2] Jinchun, Huijun Zhu, James Njuguna and Hrushikesh Abhyankar. Recent Development of glass Fibres and Their Reinforced Composites Based on Different Polymeric Matrices. Materials 2013, 6, 5171-5198
[3] Andersons J., Sparnins E., Joffe R., Wallström L. Strength distribution of elementary glass fibres. Composites Science and Technology, 2005 65: p. 693-702.
[4] Andersons J., Joffe R., Sparnins E. Stiffness and strength of glass fiber/polymer matrix composites. Polymer Composites, 2006 27(2): p.221-229.
[5] R. Manohar Reddy.Innovative and Multidirectional Applications of Natural Fibre, glass - A Review. Academic Journal of Entomology 2 (2): 71-75, 2009
[6] Md. Minhaz-UlHaque, Mst. Ayesha AktherZaman, M. H. Rahaman,M. Z. Hossain, M. Maniruzzaman. Thermal and tensile mechanical behavior of acetic anhydride treated glass fibres. International Journal of Materials Science and Applications 2014; 3(3): 106-110

