Determining Interlaminar Shear Strength of Glass Fiber/ Epoxy Resin Composite by Experiment Test

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Abstract— This project determines the inter laminar shear strength of Glass fiber/ Epoxy resin composites. The laminates or composites were made using hand layup technique considering laminate thickness, volume fraction and fiber GSM as parameters. The experiment test is conducted on the composites test specimens according to ASTM D3410. From the experiment test result it is concluded that, the thickness of specimens has a significant effect on inter laminar shear strength (ILSS) followed by volume fraction of fiber and resin, and fiber GSM.

Key words: Inter Laminar Shear Strength, Glass Fiber, Epoxy Resin, Hand Layup Technique

I. INTRODUCTION

Glass fiber/ epoxy resin composites are the fiber reinforced polymer composite materials. Fiber reinforced polymer is a composite material made of polymer matrix reinforced with the fibers. The fibers used are glass fiber, and the matrix used is epoxy resin. Fiber reinforced polymer are widely used in aerospace industry, marine, and construction industry. Fiber reinforced polymer are category of composites plastics specially use fiber material to mechanically enhance the strength of the plastics. This leads to determine inter laminar shear strength of the fiber reinforced polymer i.e., glass fiber/ epoxy resin composites. The composites or laminates were made using hand layup technique considering laminate thickness, volume fraction and fiber GSM.

A. Inter Laminar Shear Strength of Fiber Reinforced Polymer Matrix composite

Inter laminar shear strength (ILSS) is the shear strength between the laminate planes. The inter laminar shear strength are the main source of the failure of the composite materials. The failure occurs due to decrease in the strength of the material with increase in load when it is subjected to external load. The inter laminar shear strength of laminates which are made of epoxy resin is typically determined by experiment test according to ASTM standard D3410/D3410M.

Inter laminar shear strength (ILSS) is the important parameter in determining the ability of the composite to resist de-lamination damage. De-lamination damage is nothing but separation of the layer in laminates from one another when it is subjected to external load.

II. MATERIALS AND METHODS

This describes the selection of materials and methods used for preparing the composites.

A. Materials:

1) Reinforcing material:
Glass fiber of 300 GSM, 400 GSM, 600 GSM, bidirectional roving of density 2.55g/ cubic cm.
2) Matrix material:
Epoxy resin (LY556) of density 1.2g/cubic cm.
3) Hardener:
HY 951 of density 1g/cubic cm

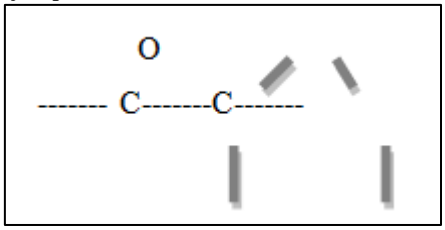
B. Glass Fiber

Glass fiber is commonly used reinforcing material in polymer matrix. The glass fibers are classified in to three categories, E-Glass, S-Glass and C-Glass. . E-Glass is known in the industry as a general purpose fiber for its strength and electrical resistance. It is the most commonly used fiber in the fiber reinforced polymer composite industry. The S-Glass is for high strength and C-Glass is for high corrosion resistance. The E-Glass fiber is shown in figure 1.

Fig. 1: E-Glass fiber.

C. Epoxy Resin

Epoxy resin is polyether resins containing more than one epoxy group capable of being converted into the thermo set form. The epoxies may be named as oxides, such as ethylene oxides (epoxy ethane), or 1, 2-epoxide. The epoxy group also known as oxarine contains an oxygen atom bonded with two carbon atoms, which in their turn are bounded by separate bonds as in scheme:



D. Method

Hand layup is the method or technique used for preparing composite laminates.

1) Hand Lay-Up Technique

In this hand layup technique the material placed or positioned manually in the mould, and resin is poured over the reinforcement material. The trapped air is removed manually by squeezing or using roller to generate the laminate structure. The same procedure is repeated for building up next layer in the laminates.

Totally 9 specimens are prepared followed by volume fraction of fiber and resin, and fiber GSM.

One of the prepared laminate is shown in figure 2.

Fig. 2: Prepared laminate

Parameter / Experiment	Laminate thickness, (mm)	Volume fraction	GSM	Compressive load (peak load) (N)	Width of test specimen (mm)	Compressive strength, (Mpa)	ILSS, (Mpa)
1	2.04	60:40	300	540	51.23	5.17	3.87
2	2.95	65:35	300	4620	50.73	30.87	23.1
3	3.89	70:30	300	900	50.26	4.60	3.48
4	1.95	60:40	400	960	53.08	9.27	6.95
5	2.95	65:35	400	420	48.52	2.93	2.20
6	3.88	70:30	400	840	51.61	4.19	3.14
7	1.95	60:40	600	1200	50.83	12.11	9.08
8	2.95	65:35	600	3860	50.52	25.90	19.42
9	3.67	70:30	600	7560	49.30	41.78	31.33

Table 1: Results

Once the composite laminates are prepared. The next step is to prepare the test specimen by fabricating the composites. The test specimens are taken and conducted the experiment test according to ASTM D3410.

III. RESULTS

According to ASTM D3410/3410M, the test is conducted on the composite test specimen and inter laminar shear strength is determined by using the formula and results are tabulated in the below table 1.

IV. DISCUSSION

From the table no.1 it is clear that, at the ¾ point of the load the shearing of the material occurs and finally breaks. The result shows that, as the parameter changes the value of load changes. Therefore inter laminar shear strength changes according to the parameter. From the results it is also found that, the laminate thickness, volume fraction and fiber GSM are the most significant parameter.

V. CONCLUSION

Based on experiment results of inter laminar shear strength of glass fiber/ epoxy resin composites of different parameter combination it is concluded that, the thickness of composite specimen has significant effect on inter laminar shear strength followed by volume fraction of fiber and resin, and fiber GSM.

ACKNOWLEDGEMENT

I express my deep sense of gratitude and indebtness to my esteemed organization “Poojya Doddappa Appa College of Engineering”, Kalaburagi which has provided me an opportunity to fulfil the most cherised desire to reach my goal. I express special gratitude to my guide Professor ArunkumarJeergi for his inspiration, guidance, constant supervision, direction and discussion in successful completion of the project. I am thankful to Dr.Indumati.B.Deshmanya Professor and Head of the Department, Department of Mechanical Engineering, for her encouragement and moral support throughout the course of work. I wish to express my sincere and obedient gratitude to Prof.Bharat.S.Kodli, course coordinator and all the members of the department for their timely help in completion of work.

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