CHARACTERIZATION OF POLYESTER BASED COMPOSITES

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Abstract— **The goal of this project is to develop new composite materials using glass fibers having higher tensile and flexural property. In our thesis, we have used weaved glass fibers as reinforcement and unsaturated polyester as matrix with catalyst and hardener (NCC8). The specimens are prepared by hand layup method as per the ASTM standards, in order to analyze the mechanical properties such as tensile and flexure strength in the GFRP composites materials. Regression models were obtained and used to predict these properties as functions of corresponding compositions of the composites. In this we are implementing the various modes of orientations such as (0/30/30/ 0) (0/45/45/ 0) & (0/ 60/ 60/ 0) respectively. These GFRP composite materials play a major role in aerofoil & automotive applications.**

Index Terms—GFRP, Tensile strength, flexure strength.

I. INTRODUCTION

In recent decades the high demand of automotive industries and related applications have generated a major field of polyester that has randomly improve and progressed to particular composite for aerospace and other application by modifying the commercial polymer to improve their mechanical properties and increase their self life. It is evident that material advances have been the key to significant technology breakthrough throughout history. There is constantly a need for stronger, lighter, and less expensive. The word composite evolved when industry required a more all-inclusive term to describe the final material resulting from the combination of many different reinforcement and matrixes. Composites as a class of engineering materials provide almost unlimited capabilities over the conventional engineering materials.

1.2 INTRODUCTION TO REGRESSION ANALYSIS

Regression analysis is widely used for prediction (including forecasting of time-series data). Use of regression analysis for prediction has substantial overlap with the field of machine learning. Regression analysis is also used to understand which among the independent variables are related to the dependent variable, and to explore the forms of these relationships. In restricted circumstances, regression analysis can be used to infer causal relationships between the independent and dependent variables. The term "regression" is now used for many sorts of curve fitting. Prism determines and graphs the best-fit linear regression line, optionally including a 95% confidence interval or 95% prediction interval bands.

Linear regression analyzes the relationship between two variables, X and Y. For each subject (or experimental unit), you know both X and Y and you want to find the best straight line through the data. In some situations, the slope and/or intercept have a scientific meaning. In other cases, you use the linear regression line as a standard curve to find new values of X from Y, or Y from X.

In general, the goal of linear regression is to find the line that best predicts Y from X. Linear regression does this by finding the line that minimizes the sum of the squares of the vertical distances of the points from the line. It assumes that your data are linear, and finds the slope and intercept that make a straight line best fit your data.

II. EXPERIMENT DETAILS

2.1 PREPARATION OF GLASS FIBRE AND MATRIX MATERIALS

A plate of dimension 4x13x115mm is fabricated by this process. PVA (polyvinyl acetate) is used as a releasing agent. First the polyester-glass composite is fabricated the material matrix (resin with hardener in the ratio of 2:1 is prepared) the resin and hardener (NCC8) are thoroughly mixed and stirred at low speed until it become uniform. The matrix material was poured in to the mould slowly in order to avoid air trapping the mixer was left for two minutes so that it becomes a little tacky. After that the glass fibre polyester was laid on the matrix layer, which was covered by another layer of matrix by pouring the mixer of slowly on to the surface of the fibre a small pressure is applied using a roller to distribute the matrix material. The setup is cured in sunlight until

it fast dry and rigid. The same procedure is followed for the fabrication of 0/30/30/0, 0/45/45/45/0 and 0/60/60/0 orientation.

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2.2 RESULT AND DISCUSSION

The glass polyester composite test specimen is tested in the universal testing machine and the stress-strain values at various points are noted and tabulated this stress strain curve for different orientation are given below. From the graph it is noted that the curve is linear and obey Hooke's law from this curve young's modulus value can be found using the formula

2.3 TENSILE TESTS

The tensile tests were conducted on three samples of composite. The tensile test was carried out in instron universal testing machine. The following results were obtained as shown in the table below. As the volume fraction of glass fiber increases, the modulus of the composite system increases, but at the same time the system becomes more brittle. The shape of the stress–strain curve indicates that as the volume fraction of the glass fiber increases, the composites become stronger and harder.

The variation in tensile strength as a function of relative change in volume fraction in glass composites. The tensile strength increases with increase in volume fraction of glass fibers.

SPECIMEN (1)

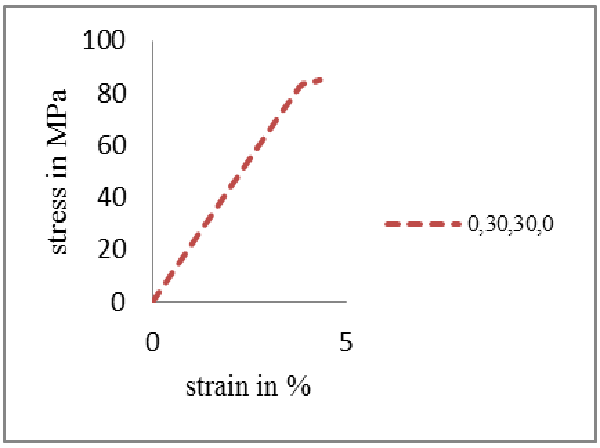

Fig. 2.1.Stress-Strain curve for sample 1

SPECIMEN (2)

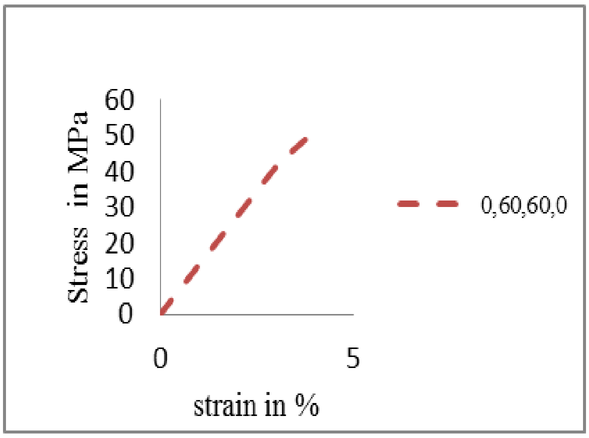

Fig.2.2 Stress-Strain curve for sample 2

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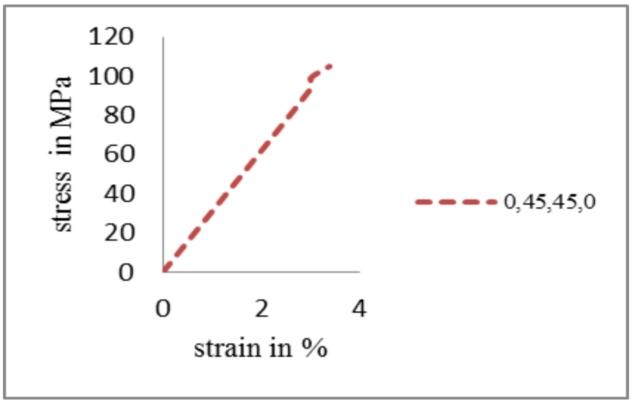

Fig.2.3 Stress-Strain curve for sample 3

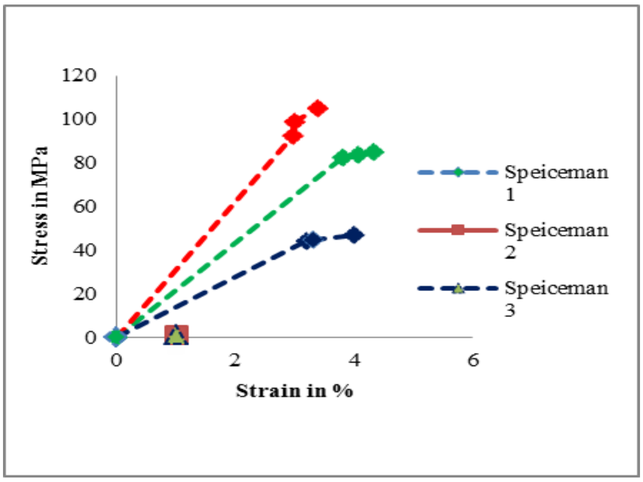

Fig.2.4Comparesion of stress vs. strain curve

ORIENTATION	Tensile strength	Young's modulus
Glass fiber	**MPa**	**GPa**
0/30/30/0	83.73	21
0/45/45/0	98.76	32.5
0/60/60/0	73.78	13.2

Table.1

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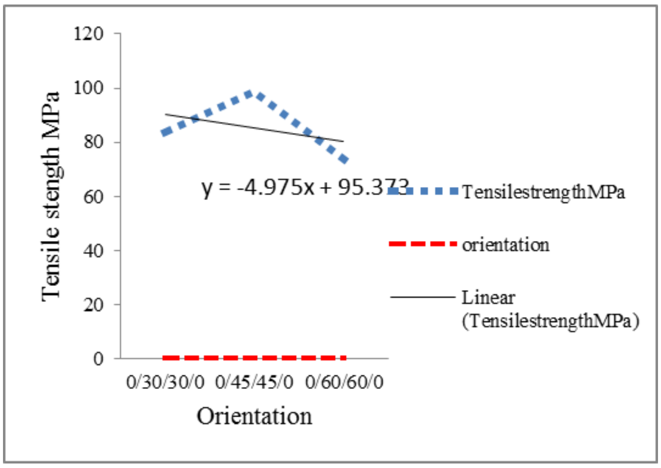

Fig.2.5 Comparison of tensile strength with regression analysis and orientation

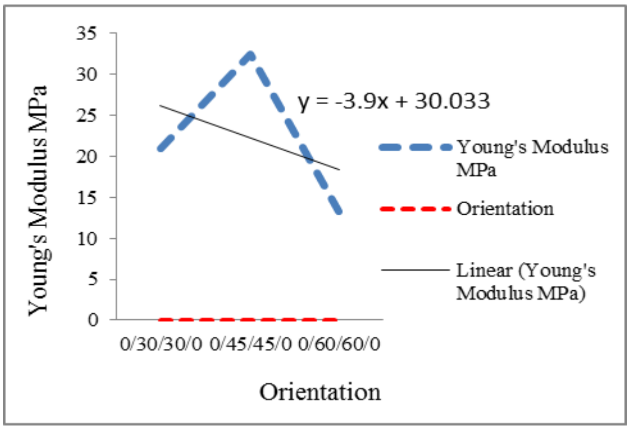

Fig.2.6 Comparison of Young's modulus with regression analysis and orientation

From above experiment results, it was observed that the maximum tensile strength of 98.76Mpa is found for the volume fraction of Glass fiber/Epoxy (1/1) and orientation (0/45/45/0) composite. And also young's modulus (32.5GPa) for that volume fraction was same ratios of composites.

2.4. FLEXURAL TESTS

The Flexural tests were conducted on three samples for each composite. The flexural was carried out in instron universal testing machine. The following results were obtained as shown below. When loaded in flexure can fail in tension either longitudinally or transversely, or shear in the matrix, interface, or fiber. Show the Figures depict the flexural strength and of GFRP as a function of volume fraction of glass fibers. As a result of the increased glass fiber content, the flexural strength increases due to the resistance to shearing. For glass composites, the flexural modulus regularly increases with increase in volume fraction of glass.

Table.2

Orientation	Experimental results	
	Flexural strength	Flexural modulus
Glass Fiber	MPa	GPa
0/30/30/0	258.59	16.23
0/45/45/0	272.91	27.89
0/60/60/0	240.43	11.42

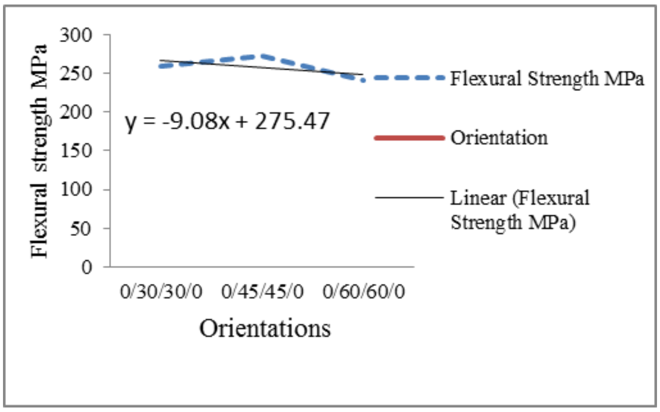

Fig.2.7 Comparison of flexural strength with regression analysis

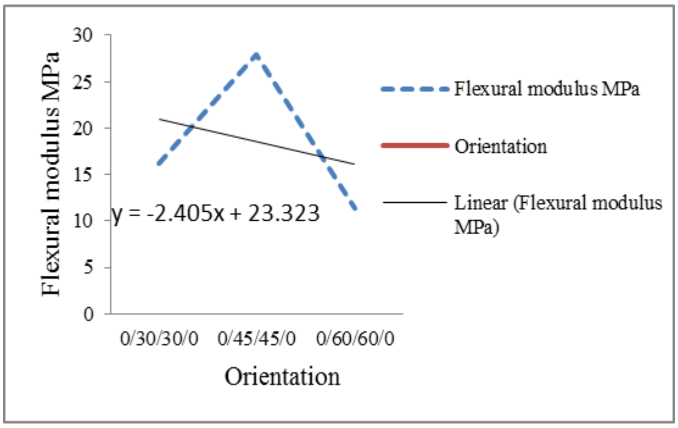

Fig.2.8 Comparison of flexural modulus with regression analysis

From above experiment results, it was observed that the maximum flexural strength of 272.91Mpa is found for the volume fraction of Glass fibre/Epoxy (1/1) and orientation (0/45/45/0) composite. And also Flexural modulus (27.89GPa) for that orientation was higher than other orientations of composites

IV. CONCLUSION

The Glass fiber approach has been made use of in order to make cost effective composites. The variation of tensile strength of glass fiber-based on long glass fiber composites has been studied as a function of the orientation behavior of the glass fiber. It occurs the tensile strength is depends upon the volume fraction of fiber content. Maximum tensile

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strength of glass fiber composite of fiber volume fraction (0/45/45/0) is found to be 98.76Mpa; flexural strength of that glass fiber composite is 272.91Mpa.

V. REFERENCES

1. ASTM (1997), Standard test method for in-plane shear response of polymer matrix composite materials by tensile test of a ±450 laminate, ASTM -3518M, Vol. 15.03, American Society for Testing and Materials, PA

2. Fukui Y, Yamanaka N, Enokida Y. Bending strength of an Al Al3Ni functionally graded material. Composites Part B: Engineering 1997; 28B:37 43.

3. Springer G.S., Environmental effects on composite materials, Vol. 2, (1984), Lancaster, PA: Technomic publishing co. Inc.

4. ASTM (1997), Standard test method for tensile properties of polymer matrix composite

5. Chamis C.C, Test methods and design allowables for fibrous composites, American Society for Testing and Materials, ASTM STP 734, (1981).

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