Mechanical Characterization and Comparison of Glass Fiber and Fiber Reinforcement with Aluminium Alloy (GFRAA) to Improve the Strengthening for Automotive Applications

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***Abstract*:- Fiber metal laminates are good candidates for advanced automotive applications due to their high specific mechanical properties. The most important factor in manufacturing of these laminates is the adhesive bonding between aluminum and FRP layers. In this study several glass-fiber reinforced laminates and glass fiber reinforced with aluminium were manufactured. Mechanical Tests like Tensile, Compression and Impact test (Izod test) were carried out based on ASTM standard were then conducted to study the strength of both the laminates under specific conditions and their resistance towards loads and impact behavior of these laminates are observed. In this experiment we find that the tensile and impact strength of the glass fiber with Al is higher than the glass fiber alone. This result will produce the more fusible and dynamic properties in the composite structure. The strength of the glass fiber with al is more than the glass fiber laminate.**

Key words: Hybrid, Glass Fiber, glass fiber with Al

1. INRODUTION OF COMPOSITE MATERIAL

Basic requirements for the better performance efficiency of an aircraft are high strength, high stiffness and low weight. The conventional materials such as metals and alloys could satisfy these requirements only to a certain extent. This lead to the need for developing new materials that can whose properties were superior to conventional metals and alloys, were developed. A composite is a structural material which consists of two or more constituents combined at a macroscopic level [1]. The constituents of a composite material are a continuous phase called matrix and a discontinuous phase called reinforcement. In the highly competitive airline market, using composites is more efficient. Though the material cost may be higher, the reduction in the number of parts in an assembly and the savings in the fuel cost makes more profit. It also lowers the overall mass of the aircraft without reducing the strength and stiffness of its components.

2. FIBER REINFORCED POLYMER (FRP)

The fiber reinforced composites are composed of fibers and a matrix. Fibers are the reinforcing elements and the main source of strength while matrix glues all the fibers together in shape and transfers stresses between the reinforcing fibers. Sometimes, filler is added for smoothen the manufacturing process and to impact special properties to the composites [2].

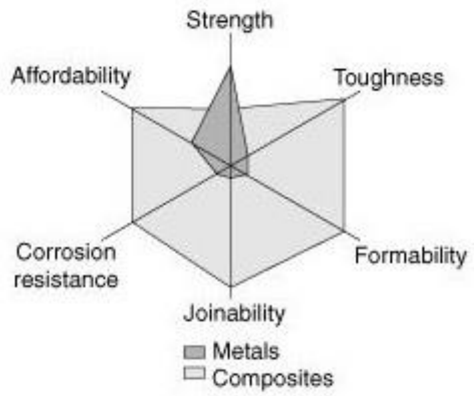

Fig.1 Properties of Conventional materials

3. METHODOLOGY

The specimens were prepared with the glass fiber epoxy laminates with Aluminum alloy according to the ASTM standard. The specimens were undergoing for mechanical testing by Universal testing machine and Impact testing machine. These results were compared with and without aluminum alloy [3].

4. LITERATURE REVIEW

The purpose of this literature review is to provide background information on the issues to be considered in this thesis and to emphasize the relevance of the present study. This treatise embraces some related aspects of polymer composites with special reference to their mechanical property with aluminum.

Jane Maria Faulstich de Paiva: This paper shows a study involving mechanical (flexural, shear, tensile and compressive tests) and morphological characterizations of four different laminates based on 2 epoxy resin systems (8552TM and F584TM). The results show that the F584-epoxy matrix laminates present better mechanical properties in the tensile and compressive tests than 8552 composites. Further it is observed that PW laminates for both matrices show better flexural and inter laminar shear properties [4].

J. Davies and H. Hamada: Investigated the flexural properties of hybrid unidirectional fiber reinforced polymer (FRP) composites containing a mixture of carbon (C) and silicon carbide (SiC) fibers were evaluated at span to depth (S/d) ratios of 16, 32, and 64. The hybrid composite flexural strength was generally higher than either the pure CFRP or SiC fiber composites. The work of fracture was a factor of 2.6 larger for the S 4 /C 4 specimen compared to the S specimen and suggests that these hybrid FRP composites may have a role as energy absorption materials. The compressive stress, compressive strain and modulus to failure of the SiC fiber were estimated to be 3.46 GPa, 157 GPa, and 0.018, respectively. Most of the specimens exhibited out-of-plane pairs of conjugate kinks although specimens with larger SiC fiber were more inclined to show evidence of shear failure [5].

Gill, R.M: Carbon Fiber polymer-matrix composites have started to be used in automobiles mainly for saving weight for fuel economy. The so-called graphite car employs carbon Fiber epoxy-matrix composites for body panels, structural members, bumpers, wheels, drive shaft, engine components, and suspension systems. This car is 570 kg lighter than an equivalent vehicle made of steel. It weighs only 1250 kg instead of the conventional 1800 kg for the average American car. Thermoplastic composites with PEEK and polycarbonate (PC) matrices are finding use as spring elements for car suspension systems [6].

GFRP LAMINATE In this laminate,
REINFORCEMENT: **Glass Fiber Reinforcement Plastic**
FIBER: **E-glass**
MATRIX: **Epoxy**.
Correct ratio of resin and hardener is **2:1**
Resin: **LY556**
Hardener: **HY951**

5. TESTING

In view of this, the present work is to investigate the mechanical properties like Tensile, Flexural (compression) and Impact Strength of glass fiber epoxy laminate with and without Aluminum alloy [7].

5.1 TENSILE TEST

Tensile load applied to a composite. The response of a composite to tensile loads is very dependent on the tensile stiffness and strength properties of the reinforcement fibers, since these are far higher than the resin system on its own. Test was carried out with the help of UTM (Universal Testing Machine) [8].

Fig.2 Universal Testing Machine (UTM)

5.2 Tested Specimen for Tension Test:

Fig.3 Tension Test using UTM

5.3 Tested Specimen for Flexural Test:

Fig.4 Flexural Test using UTM

6. IMPACT TEST

Static tension tests of the un-notched specimen's do not always reveal the susceptibility of metal to brittle fracture. This important factor is determined in impact tests. In impact tests we use the notched specimen's

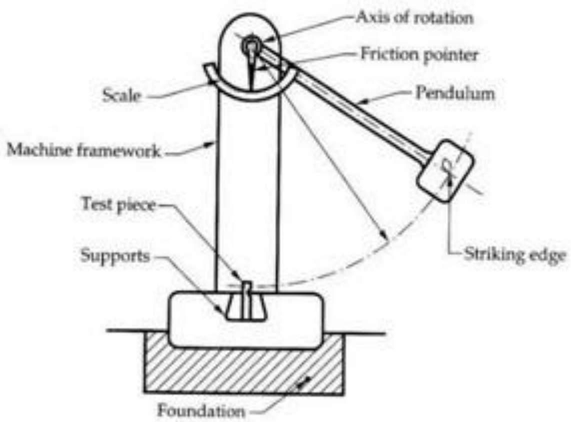

Fig.5 Process of Impact Test

6.1. Tested Specimen:

Fig.6 Notched Specimen's using Impact Test

7. RESULTS ANALYSIS

Table: 1 GFRP-AL TENSILE TEST

Test Parameters	Observed Value			
	ID-1	ID-2	ID-3	ID-4
Gauge Width(mm)	24.12	24.29	24.33	24.15
Gauge Thickness (mm)	3.20	3.25	3.16	3.17
Original Cross Sectional Area(mm^2)	77.18	78.94	76.88	76.55
Ultimate Tensile Load (KN)	26.78	25.99	27.10	27.02
Ultimate Tensile Strength(N/mm^2)	346.98	329.23	352.50	352.97

Table: 2 GFRP-AL FLEXURAL TEST RESULTS

Test Parameters	Observed Value			
	ID-1	ID-2	ID-3	ID-4
Gauge Width(mm)	25.12	25.10	25.33	25.68
Gauge Thickness (mm)	3.45	3.55	3.29	3.32
Original Cross Sectional Area(mm^2)	86.66	89.11	83.33	85.26
Ultimate Tensile Load (KN)	1.12	1.33	1.17	1.21
Ultimate Tensile Strength(N/mm^2)	12.92	14.92	14.04	14.19

Table: 3 GFRP-AL IMPACT TEST RESULTS

Test Temperature	Notch type	Specimen Type	Absorbed energy Joules				Average
			ID-1	ID-2	ID-3	ID-4	
25^0 C	Notched	60 x 10 x 3.5	07	09	11	09	9.00

8. FUTURE SCOPE

In this regard the laminate will prepare according to study the thermal characterization and mechanical characterization. FMLs consist of metallic alloy and fiber reinforced prepreg. Mostly commercially available GLARE, ARALL and CARALL consist of various aluminium alloys. Many researchers have been trying to use possible metallic alloys such as magnesium, titanium, etc. instead of aluminium alloys. It is expected that this diversity gives optimum mechanical properties. Same efforts have been examined for engineering polymeric materials to replace fiber reinforced prepare.

9. CONCLUSION

From the obtained result we find that the tensile and impact strength of the glass fiber with Al is higher than the glass fiber alone. This will effect in the application like automobile, aeronautical and marine structures.

This result will produce the more fusible and dynamic properties in the composite structure. The strength of the glass fiber with al is more than the glass fiber laminate.

In the flexural strength of will not be increased during the reinforced the al with glass fiber, but during the testing the glass fiber with al specimen was not broken which cause the bending only. So that the elastic property is high when compare with glass fiber alone.

After releasing the load the glass fiber al specimen’s was tried to regain to original level, which will increase the elastic property of the laminate.

Also conclude that, even when increases the strength also will not effect on the actual weight and cost of the laminate since that al is lighter and cheaper.

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