Fabricaion of Wingtip Using Composite Material

S. Kanimozhi Priya[1], M. Kiruthika[2], A. Vivekananthan[3]
[1, 2, 3] Dept of Aeronautical Engineering
[1, 2, 3] Tamil Nadu.

Abstract- *The wingtip is the device which is attached to the wing of the aircraft. This wingtip is used in the reduction of total drag which results in increase of coefficient of lift that produced. Here the wingtip device may be fabricated by using metals, woods and composite materials. Composite material is the material which is made by the combination of two or more materials which results I the reduction of weight. The main aim of this paper is to deliver an idea that the wingtip of Cessna 152 can be fabricated by using composite materials. In this project we have compared the current composites materials that are used in the aerospace applications by using that comparison one combination will be selected and the final product will be brought out.*

Keywords- Glass fibers, testing, fabrication.

I. INTRODUCTION

The composite material have become essential part in the field of aeronautical engineering, as it have advantages like low cost, less weight, stiffness, etc,. The wingtip assembly is attached to the wing structure in the same manner as the conventional design.Fiber presents very flexible design solutions, due to its extraordinary fabrication adaptability, high durability and structural efficiency (strength-to-weight ratio) and its usage also benefits from increasingly low production. As a possible alternative to the wingtips structure which uses conventional materials and designs. An advanced composites and an advanced metallic design concepts were lay out.

Table. 01 Comparison Of Fiber Materials

ARAMIDE FIBER	CARBON FIBER	GLASS FIBER
Max melting point = >500	Max melting point = 400	Max melting point = 2075
Strength = .7 – 3.5 GPA	Strength = 3.5	Strength = 5.2
Fiber weight fraction = 0.55	Fiber weight fraction =0.40	Fiber weight fraction = 0.60
Tensile strength = 65250	Tensile strength =66700	Tensile strength = 50000
Tensile modulus = 4.35	Tensile modulus = 4.35	Tensile modulus = 7.24
Specific tensile strength = 49810	Specific tensile strength = 4764	Specific tensile strength = 4650

II. MATERIAL AND FABRICATION

The composite material that we used is E glass fiber and S glass fiber with Epoxy resin and Hardener. By comparing the E Glass fiber plate and S Glass fiber, the main material will be selected for the fabrication of wingtip.

E-GLASS FIBER

E-Glass is a low alkali glass having composition of SiO_2 54wt%, Al_2O_3 14wt%, CaO+MgO 22wt%, B_2O_3 10wt% and Na_2O+K_2O less than 2wt%. Some other materials may also be present. E glass fiber is a light weighted fiber. This type of fiber is used for reinforcement, especially for laminates of electronic appliances.

FIG. 1. E-Glass Fiber

S-GLASS FIBER

S-Glass fiber has a typical nominal composition of SiO_2 65wt%, Al_2O_3 25wt%, MgO 10wt%. This type of glass fiber is having 20% higher modulus than other fiber materials. It is having stronger formulation for structural composite application. It is having high creep rupture and high temperature application.

Fig. 2. S-Glass Fiber

EPOXY RESIN

Epoxy resins may be reacted with themselves or with co-reactant like amines, acids, alcohols, etc, which is known as hardeners. This hardeners are used to increase the chemical reaction between the resins and makes the material more strong.

FIG. 3. Resin And Hardener

FABRICATION OF MATERIAL

For the testing purpose the composite plate has been fabricated using various fraction of fibers and resins. The composite plate which is manufactured is using E-Glass fiber and S-Glass fiber. The fabrication of plate was done by hand mould process.

The fabricated plate has been sectioned for various testing according to ASTM standards.

FIG. 4(a). Composite Plate

FIG. 4(b). Composite Plate

FIG. 4(c). Composite Plate

IV. TESTINGS

Two categories of testing have been taken for both the S-Glass fiber plate and E-glass fiber plate.

- Flexural and elongation,
- Tensile testing.

FLEXURAL AND ELONGATION

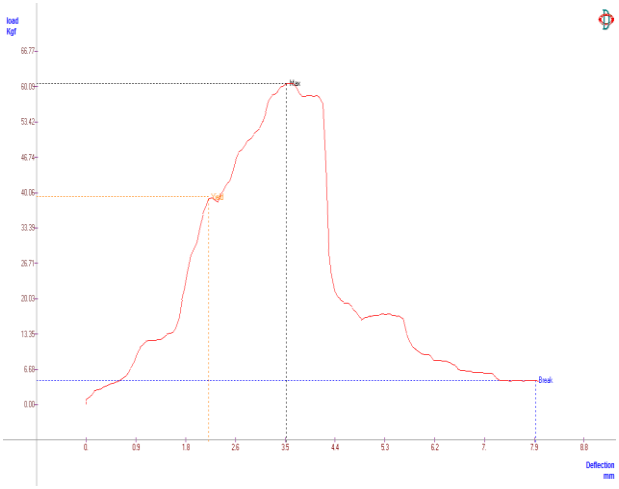
Flexural and elongation was taken in both the plates and a graph was obtained for both the composite plates which is fabricated. The graph obtained is shown in the below figure and the reading obtained is given in the below table

READING OBTAINED FOR S-GLASS FIBER

The force that applied on the S-Glass fiber and the maximum Flexural strength obtained is shown in the table. The graph is obtained for load applied and the deflection that occurs.

Table. 2

SI. No.	Results	Value	Unit
1	Force	33.4	N
2	Elongation	**33.40**	**mm**
3	M	**1.0**	**N/MM**
4	FLEXURAL MODULUS AT 1% STRAIN	**24873.78**	**N/MM²**
5	FLEXURAL STRENGTH	**46245.94**	**N/MM²**

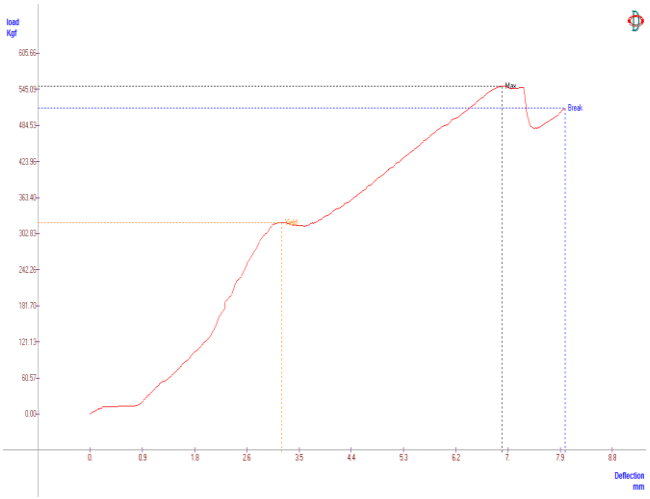


GRAPH. 1

READING OBTAINED FOR E-GLASS FIBER. Readings that are obtained foe E-Glass fiber is shown below.

TABLE. 3

SI. No.	Results	Value	Unit
1	Force	65.3	N
2	Elongation	**6.93**	**mm**
3	M	**9.4**	**N/MM**
4	FLEXURAL MODULUS AT 1% STRAIN	**24841.54**	**N/MM²**
5	FLEXURAL STRENGTH	**46186.00**	**N/MM²**



GRAPH. 2

TENSILE TESTING.

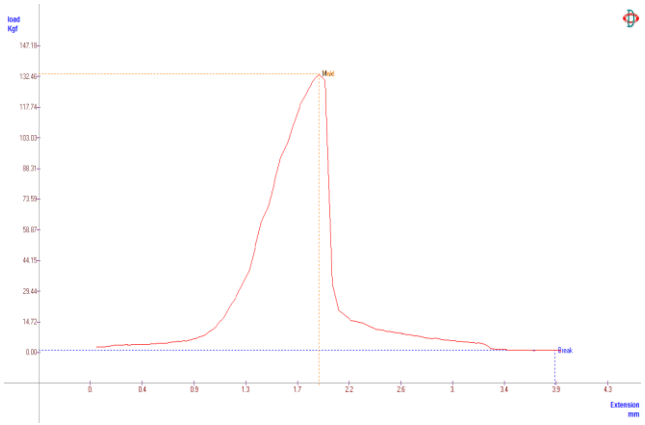
It is the testing process in which the tensile strength of the composite plate is determined and it is compared with each other. Readings that are obtained for both the composite plate is given in the below graph and table.

READINGS OBTAINED FOR E- GLASS FIBER

The maximum tensile strength of the E-Glass fiber is given below.

TABLE. 4

SI. No.	Results	Value	Unit
1	Area	**0.42**	**cm²**
2	Yield Force	**133.80**	**Kg**
3	Yield Elongation	**1.90**	**mm**
4	Break Force	**1.1**	**Kg**
5	Break Elongation	**3.86**	**mm**
6	Tensile Strength at Yield	**321.63**	**Kg/cm²**
7	Tensile Strength at Break	**2.64**	**Kg/cm²**
8	% Elongation	**2.34**	**%**
9	Max Force	**133.80**	**Kg**
10	Max Elongation	**3.86**	**mm**

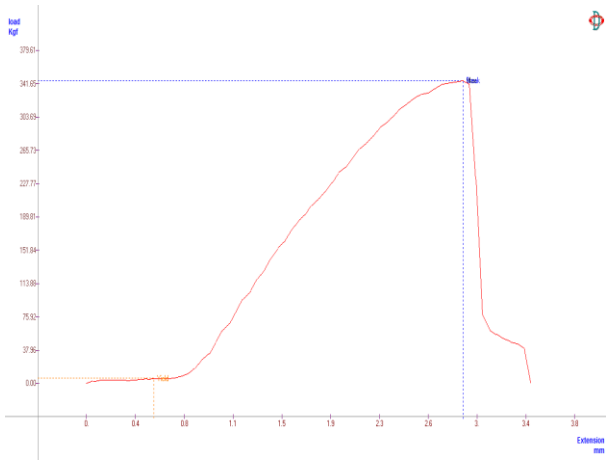


GRAPH. 3

READINGS OBTAINED FOR S-GLASS FIBER

TABLE. 5

SI. No.	Results	Value	Unit
1	Area	0.42	cm²
2	Yield Force	5.90	Kg
3	Yield Elongation	0.52	mm
4	Break Force	345.3	Kg
5	Break Elongation	2.91	mm
6	Tensile Strength at Yield	14.18	Kg/cm²
7	Tensile Strength at Break	830.05	Kg/cm²
8	% Elongation	1.76	%
9	Max Force	345.30	Kg
10	Max Elongation	2.91	mm



GRAPH. 4

V. CONCLUSION

The maximum flexural strength that obtained for S-Glass fiber is 46245.94 N/MM whereas for E-Glass fiber is 46186.0 N/MM. By comparing this flexural strength for both the fibers, S-Glass fiber is having more flexural strength that the E-Glass fiber. Similarly for tensile test, the maximum tensile obtained for S-Glass fiber is 830.05 Kg/cm² and for E-Glass fiber it is 361.6 Kg/cm². Hence, when comparing these forces and strength it is clearly showed that S-Glass fiber is having more withstand ability than E-Glass fiber.

REFERENCES

[1] Alexander Landsmann, Carlos Alexandre seruff, Eduardo de Miranda Batista, "Mechanical properties of glass fiber reinforced polymers" [Brazil].

[2] Prashanth Turla, S. Sampath Kumar, P. Harshitha Reddy, K. Chandra shekar, " Processing and flexural strength of carbon fiber and glass fiber reinforced epoxy-matrix hybrid composite", [Hyderabad].

[3] Rene Alderliesten, "On the development of hybrid material concepts for Aircraft structures" [Netherland]

[4] Edson Cocchieri Botelho, Rogerio Almeida Silva, "A review on the development and properties of continuous Fiber/epoxy/Aluminium hybrid composites for aircraft structures", [Brazil].

[5] N. Saravana kumar, G.VinothKumar, C.VinothKumar, M. Prabhu "Experimental Investigation on Mechanical Behavior of E-glass and S-Glass Fiber Reinforced with Polyester Resin",[Tamil Nadu].

[6] G.G. devyatykh, M.F. churbanov, I.V. Scripavech, G.E. Snopatin, E.M. Dianov, V.G. Plotnichenko, "Recent Developments in as S-glass fibers", [Russia].

[7] Y. Karnakar, K.Madh, "Experimental Analysis on Glass/Epoxy composite beams".

[8] Mohammad aeif, Dr. Mohammad Asif, and Dr. Israr Ahmed, "Advanced Composite Material for Aerospace Application-a Review", [Rajasthan].

[9] Adam Quilter, "Composites in Aerospace application".

[10] M. Sudheer, Pradyoth K.R, Shashiraj Somayaji, "Analytical and Numerical Validation of Epoxy/GlassStructural Composites for Elastic Models", [Karnataka].