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Design and Analysis in Carbon Fiber Composites

Avhale D.P
Postgraduate Student, ME (Design),
Govt. College of Engineering,
Aurangabad, Maharashtra, India.

Dr. U.V. Hambire
Assistant Professor Dept. of Mech. Engineering,
Govt. College of Engineering,
Aurangabad, Maharashtra, India.

Abstract:- The need for lighter vehicles is becoming more and more important for the heavy-duty industry. This can be achieved by using composite materials. One of the most promising materials is carbon fiber reinforced plastics, a composite material with carbon fibers bonded together by a polymer. Carbon fiber reinforced plastics are in many ways different from conventional materials, such as steel that is commonly used in the structural parts today. So Design and Analysis in Carbon Fiber Composites Concludes Carbon Fiber Composites materials have high strength to weight ratio. They are best suited for various heavy-duty vehicles applications. Carbon Fiber Composites materials offer high fatigue and corrosion resistance.

Keywords:- *Composite materials, design constrain, material property, and static analysis.*

I. INTRODUCTION

Now a day use of heavy-duty vehicles is increased. The aim of India to decrease the emissions with 20% compared to current emission. It can be happen by reducing the weight of the vehicles. By using light weight material the working loads of the truck and bus can be increased and the fuel consumption and the emission of CO_2 emissions to be reduced. Because of Reducing fuel consumption increases the vehicles efficiency. Near about 70 % of the fuel consumption is directly proportional to the weight of the vehicles. Near about 40% to 60% weigh of vehicles reduced by using carbon fiber composite as a alternative material for steel and aluminum. For design the light weight vehicle one of the best composites materials is carbon fiber composite. Carbon fibers are bonded together by polymers. Carbon fiber composite is not only for automobile sector but it also use in aeronautical engineering, civil engineering. Carbon fiber composite is superior to many other materials. Carbon fiber composite is best alternative material for aluminum and steel.

II. AIM

The aim of this study to find the best alternative material for aluminum and steel which can be used during design the light weight vehicle in automobile industry, aeronautical industry and structural design in civil engineering etc.

III. LITERATURE REVIEW

For reducing the weight of vehicle and heavy duty truck and bus by 40% to 50% by using carbon fiber as alternative material for steel and aluminum material. In market there is much more importance for carbon fiber composite carbon fiber composite mostly use in aerospace application like airplane Boeing 747, in which 50% structure consist of carbon fiber composite. By using carbon fiber composite as an alternative material aluminum for design the structure of airbus which reduce the weight up to 40%. Carbon fiber composite is used in the roof of the BMW M6 coupé (BMW AG) as well as in front and fenders of the Chevrolet Corvette Z06. The front fenders of the Dodge Viper are also made by carbon fiber composite material, as well as the rear deck lid inner structure of the Ford GT. Lamborghini has produced the body of one of their cars, with exception for door and roof structure, entirely in carbon fibers reinforced epoxy. The weight has been reduced with 34 kg, approximately 40 per cent compared to its predecessor that had a body in aluminum. Carbon fiber composites are also used within military.

IV. CARBON FIBER COMPOSITES

By adding two or more material in one and making a material having good properties as compare to individual one. The carbon fiber are placed in matrix are known as carbon fiber composite. Carbon fiber composite having high strength to weight ratio. The matrix is polymer or metal matrix. Matrix transfers the load to the fibers. By using different type of fiber and matrix. Carbon fiber composite manufacture with different properites.mainly polymer, metal, ceramic and carbon matrix are used. Following are the advantages of carbon fiber over the aluminum.

- Weight to strength ratio is high.
- Optimum design.
- Best fatigue life.
- High resistance to corrosion
- Stable for high temperature.

Carbon fiber composite reduce the weight of vehicle as it use alternative for aluminum and steel during design the vehicle.

A. Carbon Fiber

Carbon fiber is the back bone of composite carbon fiber having high strength. In this project composite manufacture by using carbon fiber. Carbon fiber having different types according to length short fiber and long fiber according to orientation parallel orientation and oriented right angle to each other. Long fiber having high strength as compare to short fiber. Carbon fiber composite are manufacture as isotropic or anisotropic material. Carbon fiber composite having high strength to weight ratio as compare to aluminum. Carbon fiber typically consists of 95% carbon and carbonized at circa 1000 to 1500^0c and graphite fiber contains near about 99% carbon and it carbonized at 2000^0c to 3000^0c. Carbon fiber is manufacture by using poly-acrylonitrile (PAN) and petroleum –based pitch.

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B. Matrices

The function of matrix is to maintain the orientation of fiber. Mainly polymatrix or metal matrix is used. Matrix transfers the load to the carbon fiber. In a carbon fiber composite material, the matrix material serves the following functions:

- Holds the carbon fibers together.
- Protects the carbon fibers from environment.
- Distributes the uniform loads in between fibers so that all fibers are subjected to the same stress and strain.
- Enhances transverse properties of a laminate.
- Improves impact and fracture resistance of a component.
- Helps to avoid propagation of crack growth through the fibers by providing alternate failure path along the interface between the fibers and the matrix.
- Carry interlinear shear.

V. TENSILE TESTING OF COMPOSITES MATERIAL

Tensile test is taken as per ASTM D3039 (ASTM International, 2008) with a length (L) of 250 mm, width (b) of 20 mm and a thickness (d) of 2.5 mm (ASTM International, 2008). The test is taken on universal testing machine at S. N. Metallurgical Services with Lab Ref.No. : - L-00280 Date: - 09/04/2018 and load is applied gradually up to failure of specimens and force as well as % of elongation is recorded.

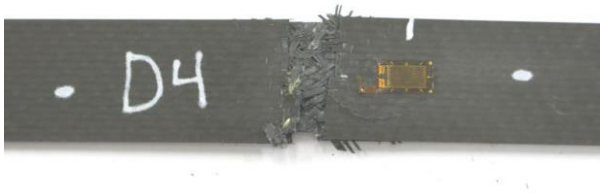

Fig 1:- Specimen after tensile test, from above

Fig 2:- Specimen after tensile test, side view

Fig 3:- Weight of Carbon Fibers Composite specimen.

Fig 4:- Weight of Aluminum specimen.

A. Observation Table for Carbon fibers Composites

Name of Lab: - S. N. Metallurgical Services.
Lab Ref.No. : - L-00280 Date: - 09/04/2018
Specimen Size: - 250 X 20 X 2.5 mm
Weight: - 21.3 gm.

Sr.No.	Test Conducted	Observations
01	Tensile Strength N/mm^2	281.50
02	% of Elongation	7.52
03	Yield Strength N/mm^2	281.50
04	Strength to Weight Ratio N/gm. cm^2	1321.6

B. Observation Table for Aluminum

Name of Lab: - S. N. Metallurgical Services.
Lab Ref.No. : - L-00281 Date: - 09/04/2018
Specimen Size: - 250 X 20 X 2.5 mm
Weight: - 32.4 gm.

Sr.No.	Test Conducted	Observations
01	Tensile Strength N/mm^2	175.81
02	% of Elongation	23.10
03	Yield Strength N/mm^2	102.36
04	Strength to Weight Ratio N/gm. cm^2	542.62

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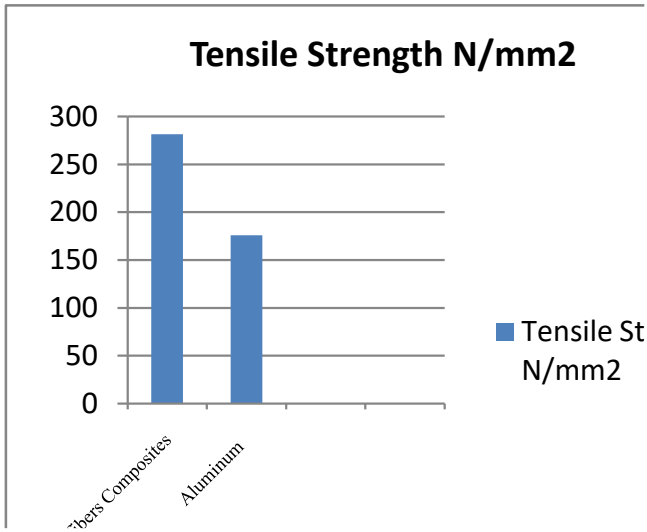

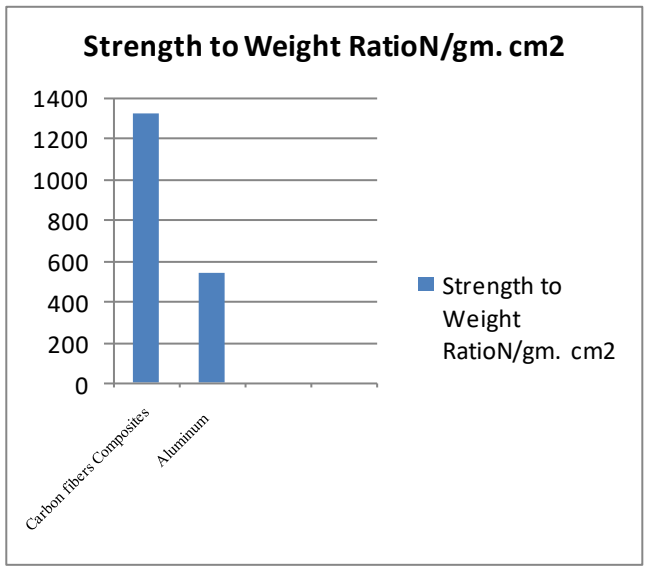

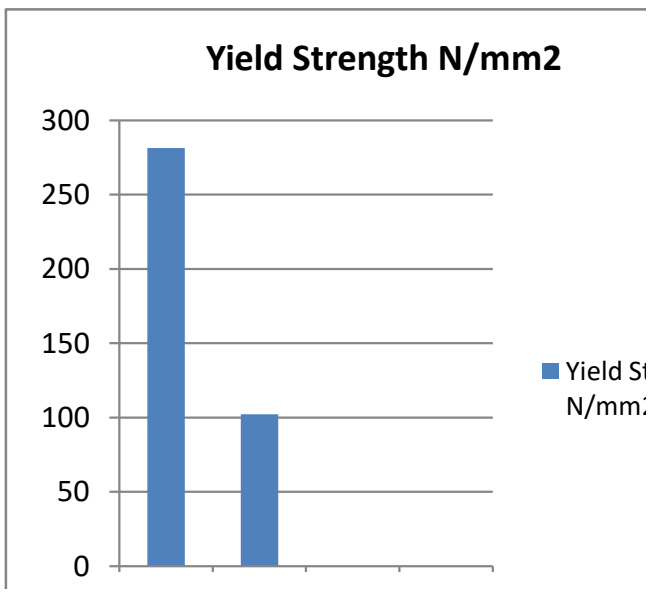

C. Discussions on result

Requirement of material for manufacturing heavy duty vehicle today is increased.so it is More important to describe properties of this two material.

- Carbon fiber Composites offer significant weight saving over aluminum.
- Carbon fiber Composites can provide structures that are 40-45% lighter than the conventional aluminum structures designed to meet the same functional requirements. This is due to the lower density of the composites.
- Unidirectional carbon fiber composites have specific tensile strength (ratio of material strength to density) about 4 to 6 times greater than that of steel and aluminum.
- Unidirectional carbon fiber composites have specific - modulus (ratio of the material stiffness to density) about 3 to 5 times greater than that of steel and aluminum.
- Carbon fiber Fiber composites are more versatile than aluminum, and can be tailored to meet performance needs and complex design requirements
- Carbon Fiber reinforced composites can be designed with excellent structural damping features. As such, they are less noisy and provide lower vibration transmission than metals.
- High corrosion resistance of fiber composites which help to reduce life- cycle cost.

VI. CONCLUSIONS

Hence we can finally conclude that:

- Carbon fiber composite have high strength to
- weight ratio as campier to aluminum.
- Carbon fiber composite are best material for design light weight vehicle in automobile industry.
- Carbon fiber composite have high fatigue and corrosion resistance than aluminum.

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