INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 89-98

DESIGN AND ANALYSIS OF ALTERNATIVE MATERIAL FOR TWO-WHEELER MUDGUARD USING NATURAL FIBER

THIRUNAVUKKARASU C[1], RAJAN P[2]
Department of Mechanical Engineering, Agni College of Technology, Chennai

Abstract—
In this project work mechanical testing and methods are used to study the material properties of mud guard fibre(ii) – reinforced polyester composites with varying fibre contents. The overall objective of this paper is to find out and compare the difference of two material which have different properties and conditions, namely the composite material GLASS FIBER AND JUTE FIBER WITH EPOXY RESIN(iii). This project is based on utilization of synthetic and natural fibers in polymer composites. These composites are subjected to (iv) give high strength and light weight fiber composite material. In this project a mechanical testing like tensile flexural and impact test conducted on a mud guard, composite material. In this project a prototype model of mud guard was prepared by our team by using the composite material (xii) and the different tests are conducted on it to know the different properties and values. And it is compared with the existing material, and then the results are concluded.

Keywords —fiber, reinforced polyester, epoxy resin, composite, tensile, impact test

1. INTRODUCTION

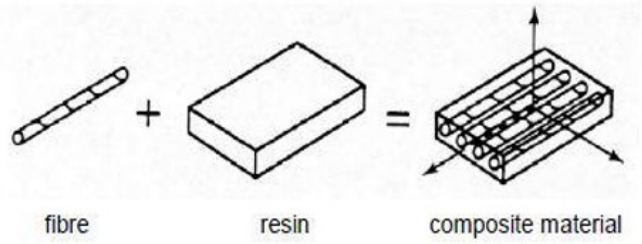
The Mud-guard of the vehicle is used to keep off mud, pebbles, and other road debris from splashing on and scratching the coat of the vehicle. The main aim is to replace the material of the mud guard, and also to prototype will be provide knowledge of varies testing like tensile, flexural, impact across the whole mud-guard due to load. The composites that are used here are GLASS FIBER AND JUTE FIBRE WITH EPOXY RESIN. These composites have high tensile strength, high flexural strength, low cost and ease of availability. Now the project mainly concentrated on reinforcement of polymer plastics with different proportions of jute and glass fiber composites. Various materials are used for mud-guard based on the strength and life requirements of it and to meet this, different manufacturing methods are used with respect to material used. We studied so many research paper in that they explain only about material characteristics but we are focusing on real time prototype model first time

A.COMPOSITES:

Composites are defined as “the engineered materials made from two or more constituent materials with significantly different physical or chemical properties which remain separate and distinct on a macroscopic level within the finished structure.Materials are selected for a given application based principally on the material’s properties. Composites have high stiffness,

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 89-98

strength, and toughness, often comparable with structural metal alloys. Composites can be excellent in applications involving sliding friction, with tri biological ("wear") properties approaching those of lubricated steel.



2. MATERIALS TESTED

A.JUTE FIBER:

Jute is a natural fiber with golden and silky shine and hence called The Golden Fiber. It is the cheapest vegetable fiber procured from the bast or skin of the plant's stem and the second most important vegetable fiber after cotton, in terms of usage, global consumption, production, and availability. It has high tensile strength, low extensibility, and ensures better breath ability of fabrics. Jute fiber is 100% biodegradable and recyclable and thus environmentally friendly. It is one of the most versatile natural fibers that has been used in raw materials for packaging, textiles, non textile, construction, and agricultural sectors.

Figure 1 Jute Fiber

B. Epoxy

Cure rates can be controlled to match process requirements through the proper selection of hardeners and/or catalyst systems. Generally, epoxies are cured by addition of an anhydride or an amine hardener as a 2-part system. Different hardeners, as well as quantity of a hardener produce a different cure profile and give different properties to the finished composites. Since the viscosity of epoxy is much higher than most polyester resin, it requires a post-cure (elevated heat) to obtain ultimate mechanical properties making epoxies more difficult to use. However, epoxies emit little odor as compared to polyesters

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 89-98

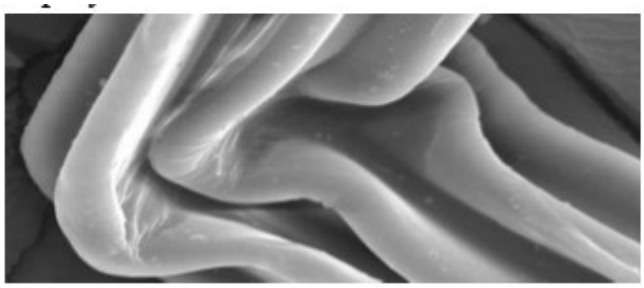


Figure 2 Epoxy Resin

3. SELECTING OF MATERIAL PROCEDURES

A.GLASS FIBRE:

Glass fiber also called fiber glass. It is material made from extremely fine fibers of glass Fiberglass is a lightweight, extremely strong, and robust material. Glass fiber has roughly comparable mechanical properties to other fibers such as polymers and carbon fiber. Although not as strong or as rigid as carbon fiber, it is much cheaper and significantly less brittle when used in composites.

B. Types of Glass Fiber:

As to the raw material glass used to make glass fibers or nonwovens of glass fibers, the following classification is known:

• A glass: With regard to its composition, it is close to window glass. In the Federal Republic of Germany it is mainly used in the manufacture of process equipment.

• C glass: This kind of glass shows better resistance to chemical impact.

• E glass: This kind of glass combines the characteristics of C glass with very good insulation to electricity.

• AE glass: Alkali resistant glass.

C. Composition of Glass Fiber:

The most common types of glass fiber used in fiberglass is E-glass, which is alumino borosilicate glass with less than 1% w/w alkali oxides, mainly used for glass reinforced plastics. Other types of glass used are A glass (Alkali lime glass with little or no boron oxide), ECR-glass (Electrical/Chemical Resistance; aluminolime silicate with less than 1% w/w alkali oxides, with high acid resistance), C-glass (alkalilime glass with high boron oxide content, used for glass staple fibers and insulation), Dglass (borosilicate glass, named for its low Dielectric constant), Rglass (alumino silicate glass without MgO and CaO with high mechanical requirements as reinforcement), and Sglass (alumino silicate glass without CaO but with high MgO content with high tensile strength).

4. Properties of Glass fiber

• Glass fibers are useful because of their high ratio of surface area to weight. However, the increased surface area makes them much more susceptible to chemical attack. By trapping air within them, blocks of glass fiber make good thermal insulation, with a thermal conductivity

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 89-98

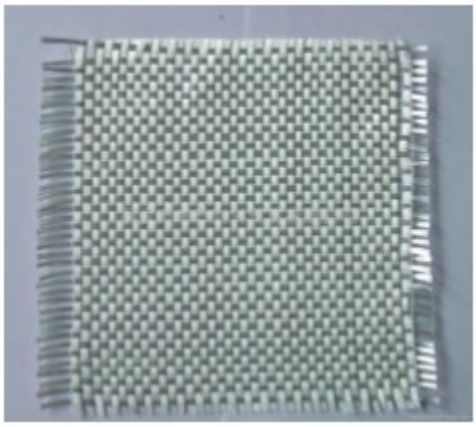


FIGURE 3 GLASS FIBER

• The strength of glass is usually tested and reported for "virgin" or pristine fibers those which have just been manufactured. The freshest, thinnest fibers are the strongest because the thinner fibers are more ductile.

• Humidity is an important factor in the tensile strength. Moisture is easily adsorbed, and can worsen microscopic cracks and surface defects, and lessen tenacity.

Glass fibre type	Oxides in weight fraction (%)				
	SiO_2	Al_2O_3	CaO	B_2O_3	MgO
E-glass	54	14	18	9	5
S-glass	65	25	-	-	10

Table 1 Glass fiber properties

5. Jute Fiber

Jute is a natural fiber with golden and silky shine and hence called The Golden Fiber. It is the cheapest vegetable fiber procured from the bast or skin of the plant's stem and the second most important vegetable fiber after cotton, in terms of usage, global consumption, production, and availability. It has high tensile strength, low extensibility, and ensures better breath ability of fabrics. Jute fiber is 100% biodegradable and recyclable and thus environmentally friendly. It is one of the most versatile natural fibers that has been used in raw materials for packaging, textiles, non textile, construction, and agricultural sectors.

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 89-98

FIGURE 4 JUTE FIBER

Features of jute:

• Jute has low pesticide and fertilizer needs. Also it is the cheapest vegetable fiber procured from the bast or skin of the plant's stem.

• It is the second most important vegetable fibre after cotton, in terms of usage, global consumption, production, and availability. It has high tensile strength, low extensibility, and ensures better breathability of fabrics. Therefore, jute is very suitable in agricultural commodity bulk packaging

• It helps to make best quality industrial yarn, fabric, net, and sacks. It is one of the most versatile natural fibers that has been used in raw materials for packaging, textiles, non textile, construction, and agricultural sectors. Bulking of yarn results in a reduced breaking tenacity and an increased breaking extensibility when blended as a ternary blend.

6. EPOXY RESIN

Epoxy resins are low molecular weight pre polymers or higher molecular weight polymers which normally contain at least two epoxide groups. The epoxide group is also sometimes referred to as a glycidyl or oxirane group.

A wide range of epoxy resins are produced industrially. The raw materials for epoxy resin production are today largely petroleum derived, although some plant derived sources are now becoming commercially available (e.g. plant derived glycerol used to make epichlorohydrin).

Epoxy resins are polymeric or semi polymeric materials, and as such rarely exist as pure substances, since variable chain length results from the polymerization reaction used to produce them. High purity grades can be produced for certain applications, e.g. using a distillation purification process. One downside of high purity liquid grades is their tendency to form crystalline solids due to their highly regular structure, which require melting to enable processing.

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 89-98

Properties of Epoxy Resin:

• High Shear Strength Adhesives:

Master Bond offers a range of one and two part epoxies with exceptionally high shear strength properties. These compounds can withstand exposure to many chemicals, resist high and low temperatures and have superior gap filling capabilities. Shear strengths in excess of 10,000 psi have been achieved with fiber reinforced epoxy compounds truly an amazing accomplishment.

• High Tensile Strength Epoxy Compounds:

Superior tensile strength adhesives from Master Bond are employed in many critical bonding applications. These compounds feature high reliability and dependability even upon exposure to hostile environmental conditions. Designed for easy application, both single and two component products are available for use.

• Strength Properties of Epoxy Compounds:

Master Bond epoxies feature outstanding physical strength properties for high performance bonding, sealing, coating, potting and encapsulation. Our polymer compounds are formulated to meet challenging physical strength requirements.

• High Compressive Strength Adhesive Systems:

Advanced formulations feature outstanding resistance to compressive forces. Products are designed for service in structural bonding applications. Specific grades offer compressive strengths as high as 15,000 and 20,000 psi at room temperature.

PROPERTIES	JUTE	GLASS	EPOXY
Density (g/cm^3)	1.3	2.5	1.08-1.2
Young's Modulus	77	55.5	3.7
Moisture absorption at 24 hrs	6.9	0.5	_
Aspect ratio	152-365	100-140	_
Specific gravity (gm/cc)	1.3	2.5	1.8
Tensile strength (MN/m2)	3400	442	85
Specific modulus (GN/m2)	28.8	42.7	_

Table 2 Properties comparison

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 89-98

Hand lay-up method procedure:

- The Releasing agent is applied uniformly on the lower mould surface.
- The resin and hardener are mixed in a separate glass jar at a ratio of 10:1.
- The resin and reinforcement are applied alternatively to get the final product.
- The mould is closed and the composite material is pressed uniformly for 32 hours under room temperature.
- After this composites are fully dry, then it is separated from the mould.

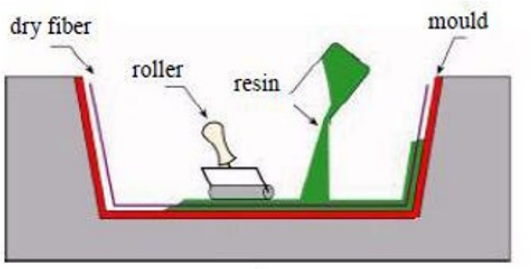


Figure 5 Hand lay-up method

7. Working Procedure

8. RESULTS AND DISCUSSIONS

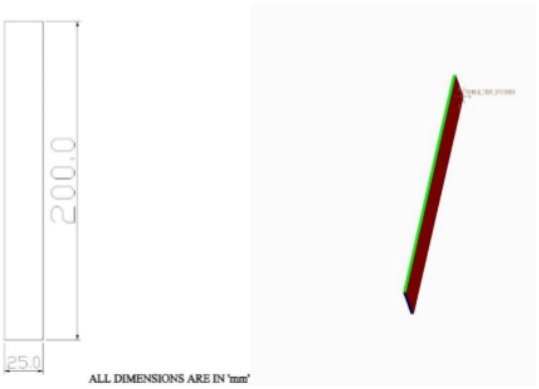
ASTM DIMENSIONS OF TEST SPECIMEN:

- The specimen is tested under Hydraulic Testing Machine by keeping the loading rate constant.
- A tensile load is applied on the specimen until it fractures.

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 89-98

• During the tensile Test, certain elongation were done on the material due to the load which will be recorded. A load elongation curve is Plotted by an x-y recorder, so that the tensile behavior of the

TENSILE TEST SPECIMEN



Impact Test:

• ASTM Standard – D 256
• The impact test is the ability of the material to withstand the sudden shock loads
• This test is conducted in a Izod method of impact testing as shown.
• The specimen made as per the specification would be kept in the machine and the load will be released.
• The absorbed energy would be indicated in the dial

IMPACT TEST SPECIMEN

Testing Result

Sample	Fiber and resin volume ratio	Tensile strength (mpa)	Flexural strength (mpa)	Impact Strength (Joule)
1.	40:60	135.23	30.28	12

ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 89-98

CONCLUSION:

• By comparing the existing material (abs) with composite (glass& jute& epoxy), we get better result like tensile, flexural and impact tests.

• It is cheaper than existing model and less weight.

• Due to limited resource available we have made a prototype.

• Further research being done to check the feasibility for mass production of the model.

• For further improvement, the results of this single polymer is compared with the results of another Jute Fiber with Glass Fiber reinforced hybrid composite.

• Material cost also very less when compared to ABS.

9. REFERENCES

i. Springer, George S., Kollar, Laszloa P. Mechanics of Composite Structures.Cambridge University Press, New York, 2003.
ii. AL-Qureshi, H. A. Automobile leaf springs from composite materials,Journal of Processing Technol., 2001.
iii. Prof.N.P.Dhoshi, Prof .N.K.INGOLE, Prof .U.D.GULHANE. Analysis and Modification of Leaf Spring of Tractor Trailer Using Analytical and Finite Element Method.IJMER. 2002; 1(2): pp-719-722.
iv. G. Goudah, E. Mahdi, A.R. Abu Talib, A.S. Mokhtar, et al.Automobile Compression Composite Elliptic Spring. IJET. 2006; 3(2): pp-139-147.
v. M. M. Patunkar, D. R. Dolas. Modelling and Analysis of Composite Leaf Spring under the Static Load Condition by using FEA.IJMIE. 2011; 1(1): pp- 1-4.
vi. VinkelArora, GianBhushan, M.L. Aggarwal. Eye Design Analysis of Single Leaf Spring in Automotive Vehicles Using CAE Tools.IJAET. 2011; 1(1): pp-88
vii. Agarwal, B.D.; Broutman, L.J.; Chandrashekhara, K. Analysis and Performance of Fiber Composites; John Wiley & Sons: Hoboken, NJ, USA, 2017.
viii. Dixit, S.; Goel, R.; Dubey, A.; Ahivhare, P.R.; Bhalavi, T. Natural fibre reinforced polymer composite materials- A review. Polym. Renew. Resour. 2017, 8, 71–78
ix. Arun Kumar, D.T.; Kaushik, V.P.; Raghavendra, R.P.S. Tensile and impact properties of jute/glass and jute/carbon fiber reinforced polypropylene. J. Polym. Compos. 2016, 4, 35–39.
x. S. Patel and U. Mansore, "Parametric Design and Comparative Analysis of Multi Leaf Spring for Light Automobile Vehicle", International Research Journal of Engineering and Technology, Vol. 5, Issue 3, pp. 2467-2473, Mar 2018.
xi. W. Ren, B. Peng, J. Shen, Y. Li and Y. Yu, "Study on Vibration Characteristics and Human Riding Comfort of a Social Equipment Cab", Hindawi Journal of Sensors, Vol. 2018, pp. 1-8, Feb 2018.
xii. B. Kabanur and Prof. P. S. Patil, "Improve the Design of Leaf Spring by Reducing the Frictional Stress", International Research Journal of Engineering and Technology, Vol. 4, Issue 8, pp. 1363-1370, Aug 2017.
xiii. W. Shi, C. Liu, Z. Chen, W. He and Q. Zu, "Efficient Method for Calculating the Composite Stiffness of Parabolic Leaf Springs with Variable Stiffness for Vehicle Rear Suspension", Hindawi Mathematical Problems in Engineering, Vol. 2016, pp. 1-12, Feb 2016.

ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 89-98

xiv. D. Kumar and A. Kalam, "Design, Analysis and Comparison between the Conventional Materials with Composite Materials of the Leaf Springs", Fluid Mechanics Open Access, Vol. 3, Issue 1, pp. 1-20, 2016.

xv. Harshit, S, Kumar and A. Verma, "Design and Simulation of Leaf Spring for TATA-ACE Mini Loader Truck using FEM", International Journal of Interdisciplinary Research, Vol. 2, Issue 10, pp. 1421-1427, 2016.

xvi. P. Shinde, P. Talekar, Y. Kamble and S. Desai, "Vibration Analysis of Composite Leaf Spring used for Passenger Car", International Conference on Recent Innovation in Engineering and Management, pp. 762-769, Mar 2016.

xvii. Ramakanth, U.S.; and Sowjanya, K. (2013). Design and analysis of automotive multi-leaf springs using composite materials. International Journal of Mechanical Production Engineering Research and Development, 3(1), 155 -162.