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Mechanical Behaviour of Aramid and Glass Fibre Reinforced Polyester Resin Composite

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Abstract:- In today's fast-moving world, vehicles form an indispensable part of human life. The yearly vehicle creation pace of the world is assessed to arrive at 100 million constantly in the year 2030. New guidelines are being made to think about the potential effect of the utilization of vehicles in the environment. The End of Life Vehicles (ELV) regulations attempt to encourage car manufacturers to shift to the use of polymer based materials. The hybridization of engineered fiber (Aramid fiber and glass fiber) gives a technique to improve the mechanical properties over common filaments. This examination is focused on the Aramid and glass fiber to upgrade the ideal mechanical properties for car bumper beam with compression moulding machine. The examples are tried in ASTM norms and compared with a vehicle guard material(bumper beam) called Glass Mat Thermoplastic (GMT). The outcomes demonstrate that some mechanical properties, for example, impact strength, compressive strength, flexural strength, tensile strength have a greater number of qualities than GMT and subsequently it would fill in as a superior substitution for GMT material.

***Keywords**:- Composite Material, Aramid Fibre, Glass Fibre, Polyester Resin.*

I. INTRODUCTION

In car fabricating industries, car bumper beams is one of the significant segments to lessen the harm to the vehicle parts for front and rear wheel drives. The fundamental capacity of a bumper system is to secure the body of the vehicle and the travellers against crash. The front bumper system comprises of three principle segments called the absorber, the bumper beam and the fascia M.M. Davoodi [1].

The fascia is normally utilized for aesthetics and to diminish the aerodynamic drag power. It is a non structural component (or) non-auxiliary segment since it can't endure the impact energy. The absorber is planned so that it retains a kinetic energy from the crash. One of the major role bumper beam helps to absorbing the kinetic energy from a high-impact collision and whereas it offers bending resistance when it comes in contact a low-impact collision. Deflection and crash strength are portions of the measures built up by officials, clients and insurance agencies for the bumper system which differ across nations. In European nations, pendulum test is the standards for the low-impact test which is set at 2.5mph (4.0 km/hr) and guarantees no harm to the bumper beam though in nations like the USA and North America, a similar test is done at 5mph (8 km/hr) in which the harm to the fascia is not considered. The real impact damping behavior in an automotive bumper system includes various parameters such as quantity, direction, contact area and position of the applied load and so it is complex to analyze it M.M. Davoodi [1]. This project work replaces the combinations with polymeric composite materials. A Composite material comprises of at least two or more fibres physically and chemically different stages suitably arranged or distributed. A composite material for the most part has attributes that are not exhibited by any of its components in isolation Al-Mosawi et al[2]. Matrix and fibers are the two segments in the composite which impacts the damage progression, loading, failure modes and the strength of the composite and inevitably the quality of the composite. For the most part, characterization of polymer composites strengthened with carbon, Kevlar, glass fibre were recorded Aswani kumar bandaru et al[6]. The performance of these composites has been generally researched and examined as far as several properties depending upon its condition of use. The performance of the compound is legitimately identified with the exhibition of the fiber, matrix and of the interface between these two components Silvio Leonardo Valença et al [8]. The hybrid composites can be produced using artificial fibers just as the natural fibres and also has combination of both fibre and resin. Aramid is one of the artificial fibres utilized in polymer composites. Aramid fibers are a type of heat-resistant and strong synthetic fibers. These are generally utilized in aviation and military applications and furthermore utilized as an asbestos substitute. Para-aramid fibre (Kevlar) is effectively accessible and it gives a unique combination of thermal stability, lightweight, durability and high quality R.Yahaya et al [9]. The properties of a few unique kinds of fibres into a single matrix have prompted the improvement of polymer composites. The properties of a hybrid composite mainly depend upon the fiber content, orientation, length of individual fibers, fiber to matrix bonding and arrangement of both the fibers. The strength of the hybrid composite is also dependent on the failure strain of individual fibres Al-Mosawi et al[2]. These days, hybrid fiber reinforced polymer composites are generally utilized because of their capacity to expand the administration life of structures and it additionally helps in decreasing the maintenance costs K. Dhinesh et al [3]. Hybrid fiber reinforced composite structures have various qualities, such as easy to apply, high strength, resistance to corrosion, etc.

II. EXPERIMENTAL PROCEDURE:

A. Details of the Materials:

In this project work, Aramid fibre and Glass fibre were gathered from K.K. Packing in Mumbai. Polyester resin was utilized to bind the fibre. Cobalt Naphthenate and Methyl Ethyl Ketone Peroxide (MEKP) were utilized as accelerator(quickening agent) and catalyst. The polyester resin, catalyst and accelerator are provided by Covai Seenu and Company, Coimbatore.

B. Fabrication of Polymer Composites:

The fabrication of polymer composite materials was done in compression moulding process. Aramid and glass fibre mats were utilized as reinforcement and polyester resin was used as matrix easy to bind the fibres. The hardener, accelerator, and low temperature curing polyester resin, were blended in a proportion of 1.5:1.5:100 by weight percentage. The mould having measurement of (300 ×300× 3) mm is used for composite fabrication. The synthetic fibres were cut into their required dimension. From the outset, the OHB sheet was applied with wax(releasing specialist) to simple expulsion of composite material from the die and both the fibres were put individually in the die included the polyester resin for every layer to effectively bind the fibres. The composite specimens of different layers with different weight percentage of fibres were prepared. In the wake of restoring, the examples of appropriate measurements were cut for mechanical test for ASTM standard. The piece and assignment of the composites arranged for this examination are recorded in Table 1.

S.NO	COMPOSITE	COMPOSITION
1	**C1**	**Aramidfibre(12%)+glassfibre(8%)+ polyester resin**
2	C2	Aramidfibre(8%)+ glassfibre(12%)+ polyester resin
3	C3	Aramidfibre(20%)+glassfibre(20%)+ polyester resin

Table 1. Composition of Specimens

C. Mechanical Properties of Composite Materials:

- *Tensile Test:*

The tensile test was finished by cutting the composite specimen according to ASTM D3039-76 standard. A universal testing machine with maximum load rating of 10 KN is utilized for testing. Three distinctive composite specimens were made which are mentioned as shown in fig.1. The specimen was held in the grip and load was applied and the corresponding deflections were recorded. Load was applied until the specimen broke and then the break load and ultimate tensile strengths were noted.

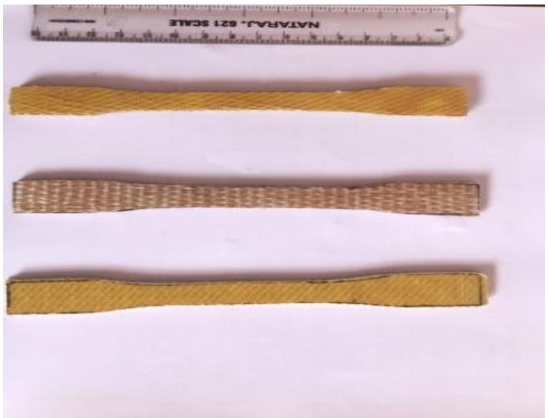

Fig.1:- specimen for tensile test

- *Flexural test:*

The Flexural test was done according to ASTM standard D790-03. The specimen bent and got fractured when the load was applied at the middle of the sample. This test was carried out in the Universal Testing Machine from which the breaking load was noted and then the flexural strength of all samples was taken.

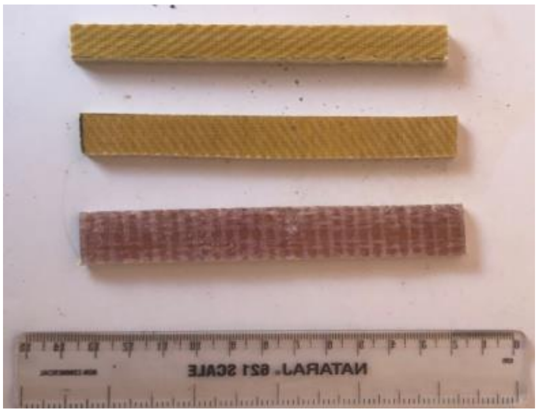

Fig.2:- Specimen for Flexural Test

- *Impact Test:*

The impact tests were done on the composite samples by the Tinius Olsen impact testing machine. The specimens were in ASTM E23 standard to measure the impact strength of the composites. Specimens for charpy impact test as shown in the fig.3.

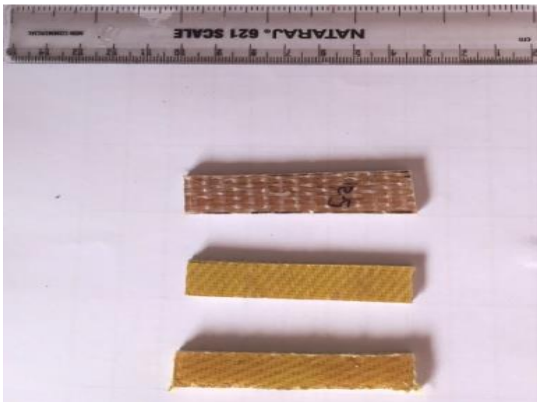

Fig.3:- Specimen for Impact Test

➢ *Compression Test:*

The compression test was done according to standard measurement (25×25×3)mm. The specimen got compressed when the load was applied at the top surface. The test was done in the universal testing machine from which the breaking load was noted and then the compression strength was taken.

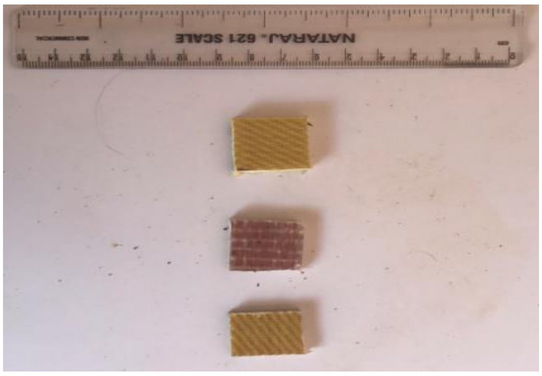

Fig.4:- specimens for compression test

III. RESULTS AND DISCUSSION:

A. Tensile Strength of Composites:

The tensile composite samples were tested to recognize the tensile properties in Universal Testing Machine and obtained tensile strength as shown in the fig.5. It is found that the tensile strength of third tensile sample is higher than the other two tensile samples. From the tensile test results, it may be inferred very well that the third composite sample has higher tensile strength than GMT.

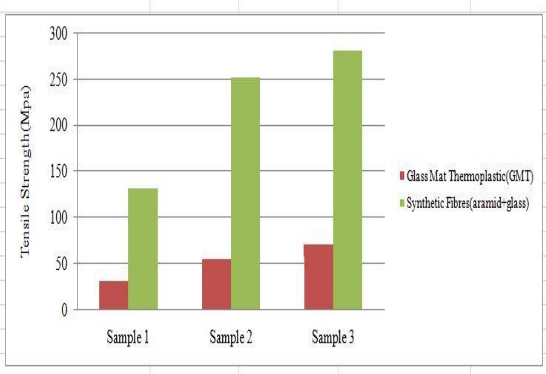

Fig.5:- Test Results of Tensile Strength

B. Flexural Strength of Composites:

The composite specimens were tested for flexural properties in UTM and got flexural strength as shown in the fig.6. It is discovered that the flexural strength of third flexural sample is higher than the other two flexural samples. From these test outcomes, it tends to be inferred that the composite 3 has higher flexural strength than GMT.

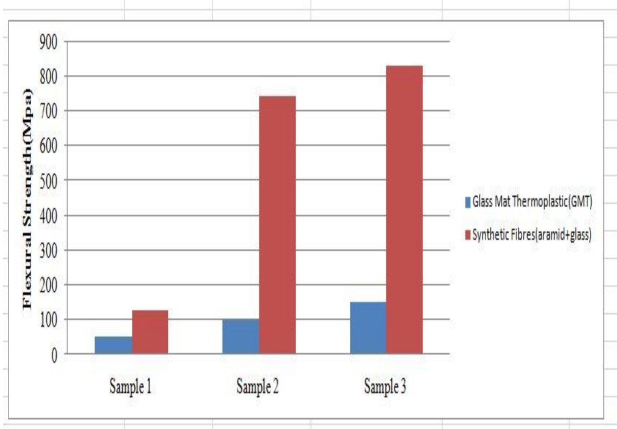

Fig.6 Test Results of flexural Strength

C. Impact Strength of Composites:

The impact test results are noted as shown in fig.7. It is found that the impact strength of third impact sample is slightly higher than the GMT. The second impact sample contains layers of glass fibre in both sides and also has higher impact strength. Hence it is difficult for cracks to propagate. The figure below shows the comparison between Energy consumed by three composites samples.

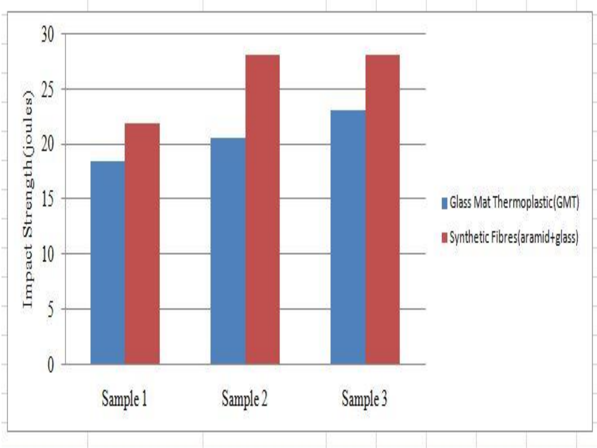

Fig.7 Test Results of Impact Strength

D. Compressive Strength of Composites:

The composite specimens were tested for compression properties in universal testing machine. The compression strength results show that they are higher than the GMT which are noted in the below figure. It is found that the compressive strength of the third compressive sample is higher than the other two samples.

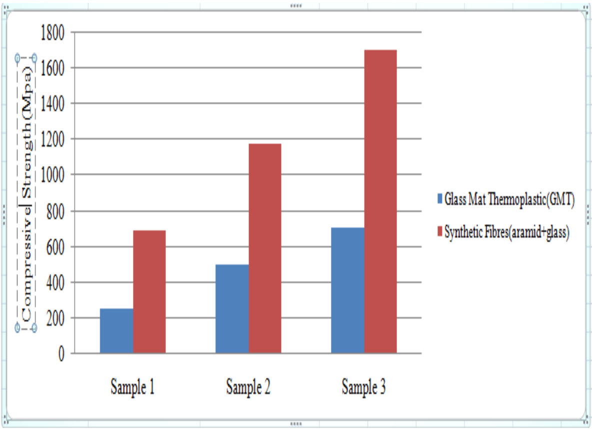

Fig.8:- Test Results of Compressive Strength

IV. CONCLUSION

The present work investigates the mechanical properties of fibre reinforced polymer composite by joining aramid and glass fibre with polyester resin. Specifically, consolidated FRP composites exposed to flexure, compression, tensile, and impact loadings were assessed by observing the stress – strain relationship. The principle findings of this project include the samples of third composite is higher in impact strength, flexural strength, tensile strength and compression strength when compared with GMT(car bumper material) since first composite samples is lesser when compared to GMT. Furthermore, only the impact strength of the second sample was nearer to the GMT material strength whereas the other mechanical properties are lower than the GMT material strength. All other polymer combination of other hybrid fibres is lesser than this composition of mechanical properties of aramid and glass fibre polymeric composite materials. Consequently it is more productive to utilize this composite material than GMT.

REFERENCES

[1]. Davoodi MM, Sapuan SM, Ahmad D, Ali A, Khalina A, Jonoobi M. Mechanical properties of hybrid kenaf/glass reinforced epoxy composite for passenger car bumper beam. Mater Des 2010;31:4927–32.
[2]. Ali I. Al-Mosawi,Mohammad H.Al-Maamori, Zaynab A.Wetwet Mechanic al Properties Of Composite Material Reinforcing By Natural-Synthetic Fibers
[3]. K.S.Navaneethan, K.Dhinesh Experimental Study On Aramid Fiber Reinforced Polymer Composites
[4]. G Gupta, A Gupta, A Dhanola and Raturi,Mechanical behavior of glass fibre polyester hybrid composite filled with natural fillers Materials Science and Engineering 149 (2016) 012091.
[5]. Alkbir M.F.M and Sapuan S.M. (2016) 'Fibre properties and crashworthiness parameters of natural fiber-reinforced composite structure', Journal of composite Structures, Vol. 148, pp. 59-73.
[6]. Aswani Kumar Bandaru, Shivdayal Patel (2016) 'Mechanical behaviour of Kevlar/basalt reinforced polypropylene composites',Journalof Composites, V ol. Part B 90, pp. 642–652.
[7]. H. Ku, H. Wang (2011) 'A review on the tensile properties of natural fiber reinforced polymer', Journal of Composites, Vol. Part B 42, pp. 856– 873.
[8]. Silvio Leonardo Valença, Sandro Griza(2015) 'Evaluation of the mechanical behaviour of epoxy composite reinforced with Kevlar plain fabric and glass/Kevlar hybrid fabric', Journal of Composites, Vol. Part B 70, pp. 1–8.
[9]. Yahaya R. and Sapuan S.M. (2015) 'Effect of fibre orientations on the mechanical properties of kenaf-aramid hybrid composites for spall-liner application', Journal of Defence Technology, Vol. 12, pp.52-58.
[10]. Yahaya R, Sapuan S, Jawaid M, Leman Z, Zainudin E. Mechanical performance of woven kenaf-Kevlar hybrid composites. J Reinforced Plastic Composite 2014;33:2242–54.
[11]. Yahaya R, Sapuan SM, Jawaid M, Leman Z, Zainudin ES. Quasi-static penetration and ballistic properties of kenaf-aramid hybrid composites. Material Design 2014;63:775–82