ANALYSIS OF COMPOSITE MATERIAL BASED ON AUTOMOBILE BODY

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ABSTRACT: Fiber metal laminates are good candidates for advanced aerospace structural applications due to their high specific mechanical properties especially fatigue resistance. 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 aluminum laminates with different bonding adhesion were manufactured. Mechanical Tests like Tensile, Compression and Impact tests were carried out based on ASTM standard were then conducted to study the effects of interfacial adhesive bonding on impact behavior of these laminates. It was observed that the damage size is greater in laminates with poor interfacial adhesion compared to that of laminates with strong adhesion between aluminum and glass layers. In addition, FMLs of with good adhesion bonding show better resistance under low velocity impact and their corresponding contact forces are about 25% higher than that of specimens with a weak bonding. Moreover, maximum central deflections in laminates with strong bonding are about 30% lower than that of FMLs with poor adhesion.

I . INTRODUCTION

A bumper is a shield made of steel, aluminum, rubber, or plastic that is mounted on the front and rear of a passenger car. When a low speed collision occurs, the bumper system absorbs the shock to prevent or reduce damage to the car. In existing bumper the weight is more. In the present trends the weight reduction has been the main focus of automobile manufacturers. Less fuel consumption, less weight, effective utilization of natural resources is main focus of automobile manufacturers in the present scenario. The above can be achieved by introducing better design concept, better material and effective manufacturing process. Steel bumper have many advantages such as good load carrying capacity. In spite of its advantages, it stays back in low strength to weight ratio. It is reported that weight reduction with adequate improvement of mechanical properties has made composites as a viable replacement material for conventional steel. In the present work, the steel bumper used in passenger vehicles is replaced with a composite bumper made of glass/epoxy composites. The objective was to compare the stress, weight, and cost savings.

II.CLASSIFICATION OF POLYMER COMPOSITES

Polymer composites can be classified into three groups on the basis of
reinforcing material.
They are:

1.2.1 Fiber reinforced polymer (FRP)
1.2.2 Particle reinforced polymer (PRP)
1.2.3 Structural polymer composites (SPC)

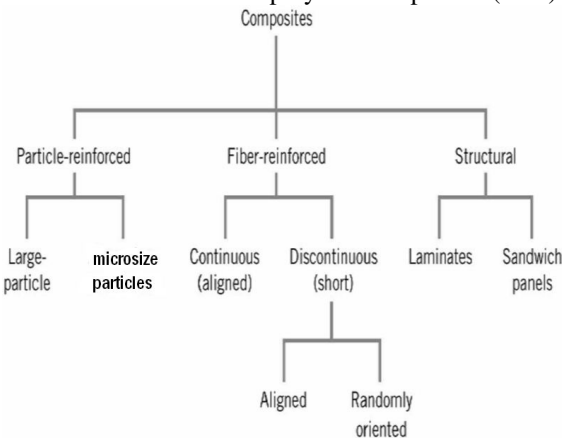


Fig.**1 Classification of polymer composites**

III.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. The fibers carry the loads along their longitudinal directions. Sometimes, filler is added to smoothen

the manufacturing process and to impact special properties to the composites .These also reduces the production cost. Most commonly used agents include asbestos, carbon/graphite fibers, beryllium, beryllium carbide, beryllium oxide, molybdenum, aluminum
oxide, glass fibers, polyamide, natural fibers etc. Similarly common matrix materials include epoxy, phenolic resin, polyester, polyurethane, vinyl ester etc. Among these materials, resin and polyester are most widely used. Epoxy, which has higher adhesion and less shrinkage than polyesters, comes in second for its high cost.

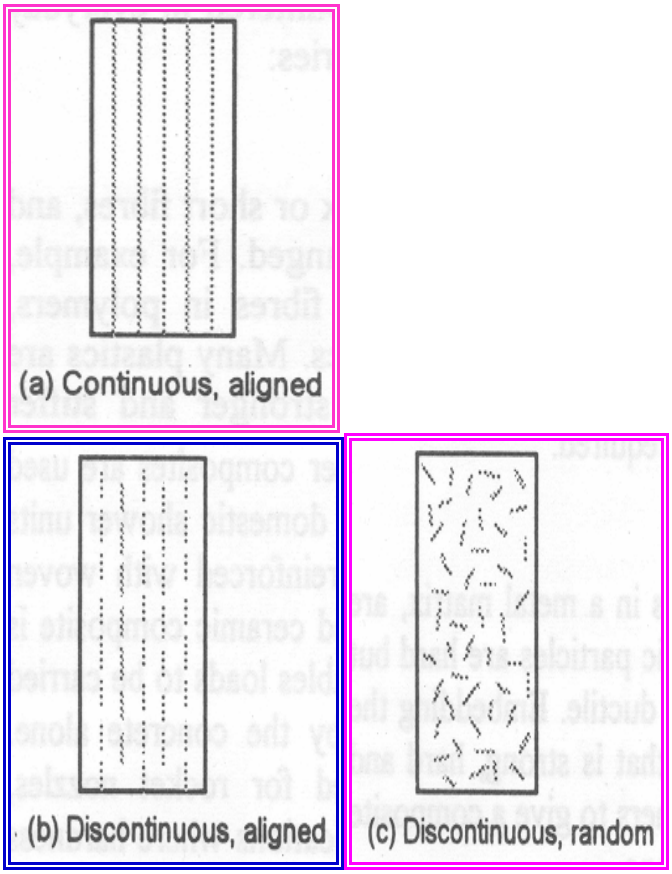


FIG 2 **TYPES OF FIBER REINFORCED POLYMER**

To measure the relative mechanical advantage of composites, two parameters are widely used, namely, the specific modulus and the specific strength. These two parameter ratios are high in composites.
The building block of a laminate is a single lamina. Therefore the mechanical analysis of a lamina precedes that of a laminate. A lamina is an anisotropic and non-homogeneous material. But for approximate macro-mechanical analysis, a lamina is assumed to be homogeneous where the calculation of the average properties are based on individual mechanical properties of fiber and matrix, as well as content, packing geometry and shape of fibers. The lamina is considered as orthotropic, so it can be characterized by nine independent elastic constants: three Young's moduli along each material axis, three Poisson's ratio for each plane and three shear moduli for each plane. Once the properties for each lamina are obtained, properties of a laminate, made of those laminae can be calculated using those individual properties.
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.

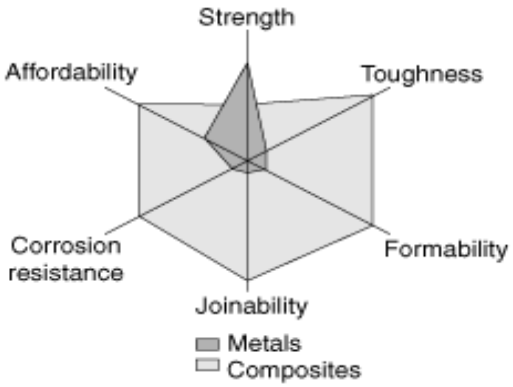


Fig.3 Comparative characteristics of metals and composites

IV.LAMINATE MATERIALS AND METHODS

This chapter describes the materials and methods used for the processing of the composites under this investigation. It presents the details of the characterization and tests which the composite samples are subjected to.

GFRP LAMINATE

In this laminate,

REINFORCEMENT - Glass Fibre Reinforcement Plastic (bi-directional type) E-glass.
MATRIX- Epoxy.
Correct ratio of resin and hardener is 10:1
Resin : LY556
Hardener : HY951

GLASS FIBRE REINFORCEMENT PLASTIC

Glass is one of the oldest known man-made materials; the practical strength of glass, however, has always been a limiting and puzzling factor. Still today the mechanical properties of glass fibres are twofold a) a special quality is the high strength b) the brittle fracture is limiting its application. An understanding of the structure of glass in relation to how and why it breaks is crucial in both improving existing applications of glasses and in new functionalities and application of all kinds of glasses, not only fibre glass.

- Fibres of glass are produced by extruding molten glass, at a temperature around 1200C through holes in a spinneret with diameter of 1 or 2 mm and then drawing the filaments to produce fibres having diameters usually between 5 to15µm The glass fibres come in variety of forms based on silica(SiO_2) which is combined with other elements to create speciality glass.

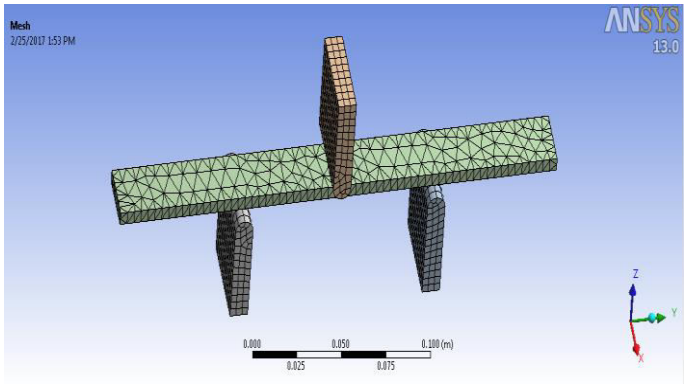
After Curing Process

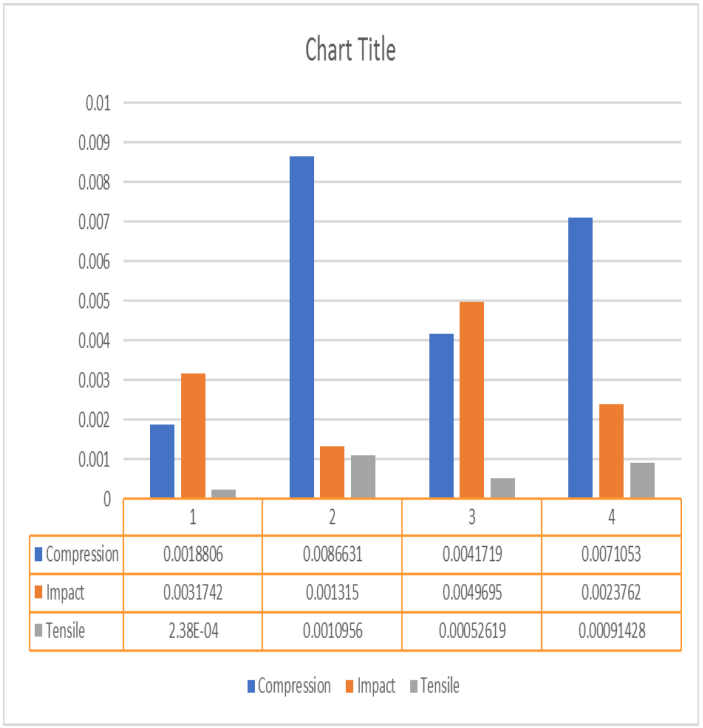
Total Deformation Bar Graph

Comparison of Ansys result of Aluminium, GFRP, GFRP-Al, GFRP-SugarCane

Tested Carried

1.Compression, 2. Impact, 3.Tensile





Were 1. Al, 2. GFRP, 3.GFRP-Al, 4.GFRP-SugarCane.

IV.CONCLUSION

From the obtained numerical and experimental result it was found that the well laminated GFRP reinforced with metal powder like aluminum fabricated bumper having more strength also lesser weight when compared to that of existing materials like steel and plastic.

According to the availability and brittle nature of the GFRP it is proposed to use the metal powders like aluminum materials. When aluminum reinforced with the GFRP materials the bonding and as well as strength also increased. The aluminum is readily available materials so it can be used in full-fledged manner for the automotive application like bumper and etc. Also from the observed result it was found that displacement was higher than the GFRP and plastic materials. This result causes the increasing failure duration. Strain rating has increased. The glass with aluminum laminated bumper materials absorb more stresses and reduces the brittle nature.

Finally it was conclude that glass with aluminum reinforced composite material based bumper material suitable for automotive application such as car bumper and etc. Also found that for bumper application the FML (Fibre Metal Laminate) materials is most suitable and its having large displacement.

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