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RESEARCH ARTICLE

EXPERIMENTAL AND COMPARITIVE ANALYSIS OF GFRAA MATERIAL WITH GFRP COMPOSITE USING ANSYS

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ABSTRACT

In the content of the advanced technology engineers and scientists have visualized and conceptualization many composite and success of their material and concepts is the materialization of their composite. In short it can be said that production and manufacturing units consummate the composite material. Thus, the industry which gives the shape of the theoretical composite material. The basic element of composite material is testing and comparing with GFRAA. To investigate the mechanical properties like Tensile, Fluxural and Impact Strength of glass fibre expoxy laminate with and without Aluminium powder using Ansys.

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INTRODUCTION

In recent times laminate composites have been increasingly utilized in such lightweight and high strength structured as ground transportation vehicles, aerospace and space structure. However composite material suffers from some serious limitation. The most significant among them is their response to impact loading. A structure is subjected to an impact force when a foreign object hits it. For instance, the loads imparted by dropped tool on the bonnet cover of car body, bird hit and runway debris on an aircraft engine are typical example of impact loads.

Composite Material: A composite material is a combination of two or more materials which retain their identities as they act in concert. These materials are usually composed of reinforcement such as a fiber and a matrix such as a resin. Nylon, fiberglass and carbon fibers and polyester, acrylic and epoxy resins are the commonly used composite materials in prosthetics and orthotics. Several factors can greatly effect the strength and performance of composite materials.

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The adhesion at the interface between the resin and fiber, and the mechanical properties of the resin and fiber, greatly effect composite performance. The fiber length, orientation and ratio of fiber to resin, and processing techniques used to fabricate the composite also effect composite properties.

Classification of Polymer Composites

Fiber Reinforced Polymer: 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 reduce 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.

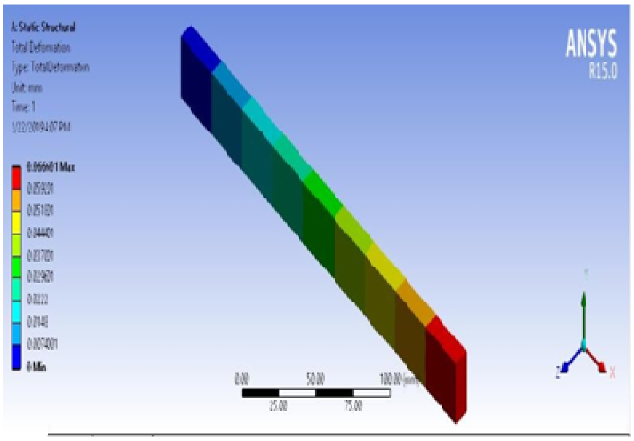


Fig. 4.1. Tensile (GFRP)

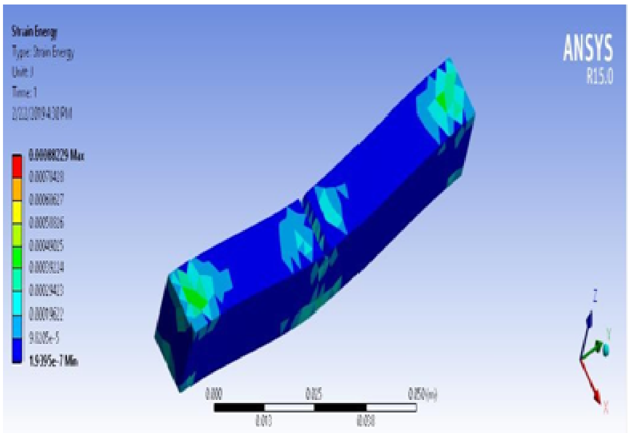


Fig. 4.2 Tensile (Gfrp+Al)

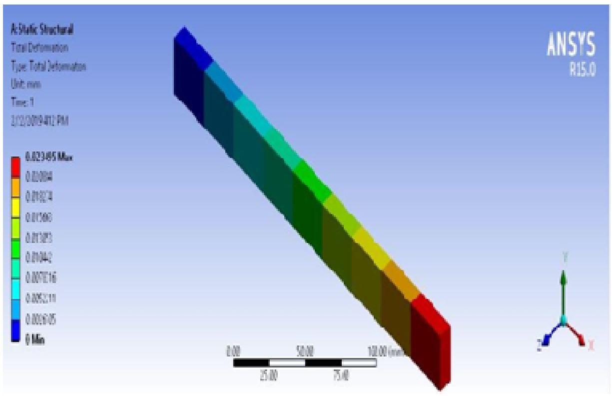


Fig. 4.3. Compression (GFRP)

Particle Reinforced Polymer: Particles which are used for reinforcing include ceramics and glasses such as small mineral particles, metal particles such as aluminum and amorphous materials, including polymers and carbon black. Particles are used to enhance the modulus and to decrease the ductility of the matrix. Some of the useful properties of ceramics and glasses include high melting temp., low density, high strength, stiffness; wear resistance, and corrosion resistance etc. Many ceramics are good electrical and thermal insulators. Some ceramics have special properties; some have magnetic properties; some are piezoelectric materials; and a few special ceramics are even superconductors at very low temperatures. One major drawback of ceramics and glass is their brittleness.

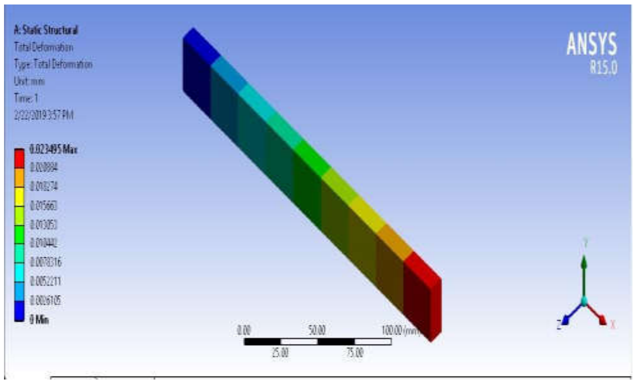


Fig. 4.4 Compression (GFRP+Al)

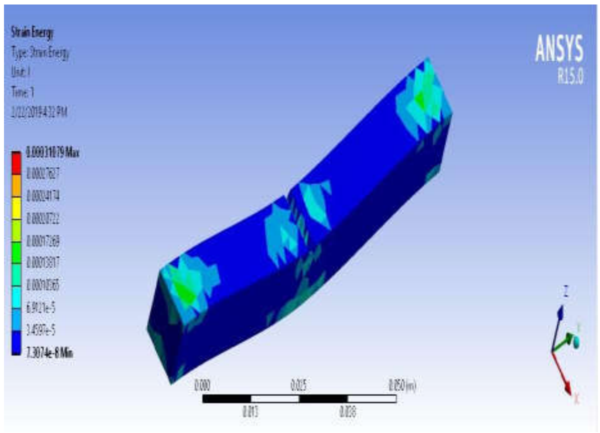
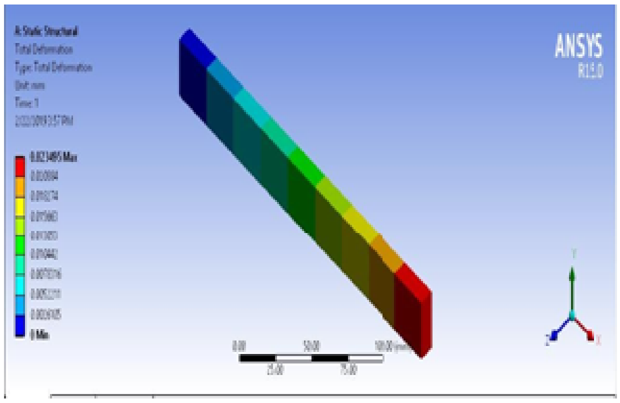
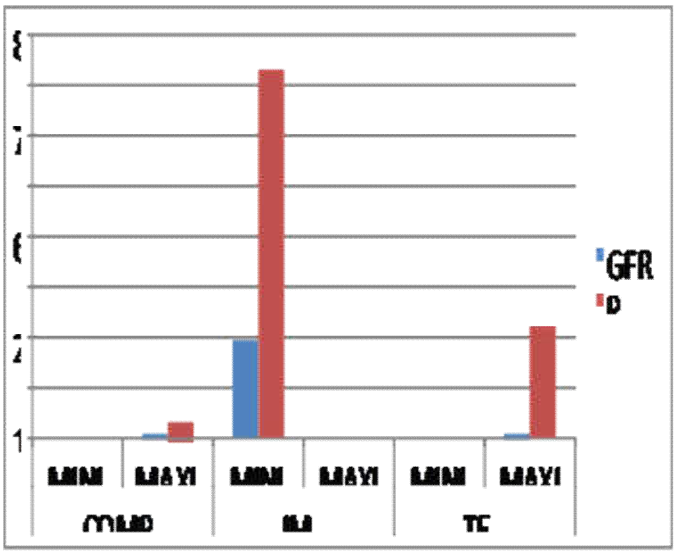


Fig. 4.6. Impact (GFRP+Al)





An example of particle –reinforced composites is an automobile tyre, which has carbon black particles in a matrix of poly-isobutylene elastomeric polymer.

Structural Polymer Composites: These are laminar composites which are composed of layers of materials held together by matrix. This category also includes sandwich structures. Over the past few decades, we find that polymers have replaced many of the conventional materials in various applications. The most important advantages of using polymers are the ease of processing, productivity and cost reduction. The properties of polymers are modified using fillers and fibers to suit the high strength and high modulus requirements. Fiber reinforced polymers offer advantages over other conventional materials when specific properties are compared. That's the reason for these composites finding applications in diverse fields from appliances to spacecraft.

HAND LAY-UP PROCESS

Hand Lay-up process was the method employed for the hybrid composite formation. It is the simplest method for the preparation of composites. The infrastructural requirement is also minimal for this method. The processing steps are quite simple and are follows.

- Initially, put thin plastic sheets as the base to get good surface finish of the product.
- Reinforcement in the woven mats or chopped strand mats form are cut as per the required size of 20 x 20 mm.
- Prepare the matrix by mixing resin and hardener in a proper ratio and spread it over plastic sheets provided as base by means of a brush.
- Now place the reinforcement above resin applied at the plastic sheet. The resin should spread properly by means of rollers to get a good base and also excess resin can be removed by the usage of rollers.
- Apply resin over the base layer and place layers in alternate order by placing resin in between them and roll it effectively.
- The top portion of the stacked composite is covered by means of a plastic sheet and finish it using rollers.
- The prepared specimen is kept at room temperature and proper loading is provided for one day.
- After a day, the loads are removed and the developed composite part is taken out.
- The curing time mainly depends upon the type of polymer used for composite formation.
- The prepared stacked composite specimen is cut into ASTM standard specimens by means of a cutter.

Since the focus of the paper was to minimise the cost as well as to obtain better property than laminate composites, two percentage of aluminium powder was used in the specimen along with glass fibre.

Experimental tests Conducted

Tensile testing: Tensile testing utilizes the classical coupon test geometry as shown below and consists of two regions: a central region called the gauge length, within which failure is expected to occur, and the two end regions which are clamped into a grip mechanism connected to a test machine. These ends are usually tabbed with aluminum, to protect the specimen from being crushed by the grips. This test specimen can be used for longitudinal, transverse, cross-ply & angle-ply testing. It is good idea to polish the specimen sides to remove surface flaws, especially for transverse tests. The specimen geometry is based on the ASTM standard 3039. The composite is cut into the desired geometry after manufacturing. Two specimens are required for the tensile testing, one with 0.2% Al & the other specimen without Aluminum.

Compression testing: A compression test determines behavior of materials under crushing loads. The specimen is compressed and deformation at various loads is recorded. Compressive stress and strain are calculated and plotted as a stress-strain diagram which is used to determine elastic limit, proportional limit, yield point, yield strength and, for some materials, compressive strength.

Impact Testing: Impact Testing, ASTM E23 and IS/ BS Standard. The impact test is a method for evaluating the toughness and notch sensitivity of engineering materials. It is usually used to test the toughness of metals, but similar tests are used for polymers, ceramics and composites.

Comparsion Result

Tensile

ELEMENT	MINIMUM	MAXIMUM
GFRP	0	0.066601
GFRP+Al	0	0.023495

Compression

ELEMENT	**MINIMUM**	**MAXIMUM**
GFRP	**0**	**0.0666601**
GFRP+Al	**0**	**0.234595**

Impact

ELEMENT	MINIMUM	MAXIMUM
GFRP	1.9395	0.00088229
GFRP+Al	7.3074	0.00031079

Conclusion

The composite materials are suitable for the application where medium load is experienced it can be effectively interchanged to the conventional material due to their advantages such as less weight, good load bearing capacity, thus it can act as are placement in Automobile Frames. In future composite materials will suitable for these application.

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