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STUDY OF TENSILE, COMPRESSIVE AND IMPACT PROPERTIES WITH AND WITHOUT FIBRE ORIENTATION FOR EPOXY GLASS FIBRE AND CARBON FIBRE COMPOSITES

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ABSTRACT

In the recent trend, application of composite materials are continuously increasing from traditional application areas such as military aircraft, commercial aircraft to various engineering fields including automobiles, robotics arms and even architecture. Composite materials are used to meet the demand for lightweight, high strength/stiffness and corrosion resistant materials. An experimental investigation was conducted to study the effect of epoxy glass fibre and carbon fibre composites specimen subjected to in-plane tensile, compressive loading and Impact Loading. The laminated specimens with various volume fractions and fibre orientations that are in accordance with ASTM standards were used in this study. The laminates are prepared at different levels of fibre orientations. Three orientations viz 0^o /90^o, +45^o /-45^o and 30^o / 60^o were considered for studies. Epoxy glass and carbon composites are fabricated using Hand lay-up technique. The fabricated specimens are subjected to tensile, compressive and impact testing to find out the effect of mechanical properties viz., tensile, compression and impact at different orientations. The experimental results help us to identify the influence of fibre orientation and thickness of the influence of fibre orientation and thickness of the composite specimens on mechanical properties

Key Words: Epoxy glass fibre, carbon fibre, fibre orientation, Tensile Strength, Compression, Impact strength.

INTRODUCTION

Composite materials are produced by combining two dissimilar materials into a new material that may be better suited for a particular application than either of the original material alone. Many of our modern technologies require materials with unusual combination of properties that cannot be met by the convectional materials. This is very true for materials that are needed for the aerospace, underwater and automotive application. Many composite materials are composed of just two phases one termed the matrix, which is continuously surrounded by the other phase, often called the dispersedphase. Fibre reinforced composites are extensively used in present day technology because of its extensive benefits, technologically the most important composites are those in which the dispersed phase is in the form of the fiber. Design of fibre reinforced polymer often included high strength and stiffness on a weight basis. Fibre reinforced composites with exceptionally high specific strengths and modulus have been produced that utilize low density fiber and matrix materials. Composite laminates offer alternative material design solutions in terms of specific strength and stiffness allowing important weight savings.

COMPOSITE MATERIALS

Composite materials consist of a combination of materials that are mixed together to achieve specific structural properties. The individual materials do not dissolve or merge completely in the composite, but they act together as one. Normally, the components can be physically identified as they interfere with one another. The properties of the composite material are superior to the properties of the individual materials from which it is constructed. An advanced composite materials is made of a fibrous material embedded in a resin matrix, generally laminated with fibres oriented in alternating directions to give the material strength and stiffness. Fibrous materials are not new; wood is the most common fibrous structural material known to man.

Examples of Composite Materials: The Nylon, Fiberglass, Carbon fibres, Polyster, acryli, Epoxy resins

Benefits and Applications: New generation large aircrafts are designed with all composite fuselage and wing structures. The repair of these advanced composite materials requires an in-depth knowledge of composite structures, materials, and tooling. The primary advantages of composite materials are their high strength, relatively low weight, and corrosion resistance.

Applications of composites on aircraft include: Fairings, Flight control surfaces, Landing gear doors, Leading and trailing edge panels on the wing and stabilizer. Interior components, Floor beams and floor boards, Vertical and horizontal stabilizer primary structure on large aircraft, Primary wing and fuselage structure on new generation large aircraft, Turbine engine fan blades, Propellers

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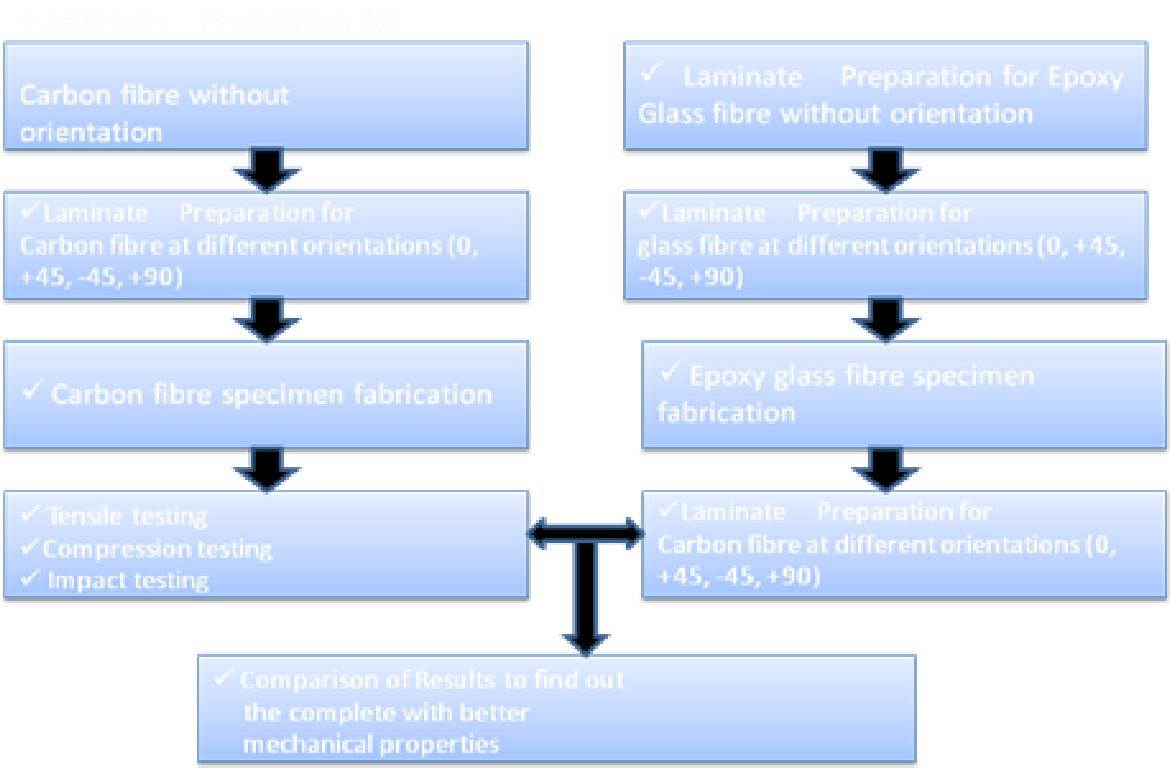
RESEARCH METHODOLOGY



RESIN: Epoxy, polyster and vinyl ester and Epoxy LY556 is selected.

TYPES OF HARDENER:

- HY951 – at room temperature.
- HT927 – temperature ranging from 80°C - 130°C
- HT974 – temperature ranging from 70°C - 80°C
- HZ978 – temperature ranging from above 100°

Moulding preparation: Fabrication by moulding is of much use for a rapid product development cycle because the tooling fabrication process is simple and relatively low cost. In open molding, there are two common methods of apply the reinforcement and resin. They are hand lay-up and spray-up. In this study hand lay-up technique is used. The preparation of mould includes the following. Two rectangular mild steel plate having dimensions of 300mm×300mm × 4mm. Chromium plated to give a smooth finished as well to protect from rusting. Four beading are used to cover compress the fibre after the epoxy is applied. Bolt and nuts are used to lock the plate.

Universal Testing Machine: The most common testing machine used in tensile testing is the universal testing machine. This type of machine has two crossheads; one is adjusted for the length of the specimen and the other is driven to apply tension to the test specimen. There are two types: hydraulic powered and electromagnetically powered machines.

The glass fibre reinforced laminated composites and the carbon fibre reinforced composites of 4mm thickness with 0, 30, 45 and 90 degree fibre orientations were manufactured as per the standard. These specimens were cut to the required shape and size as per the ASTM standards.

EPOXY GLASS FIBRE

Tensile Properties: The tensile strength is superior in case of 90 degree orientation. More force is required for fracture of carbon fibre reinforced polymer composite in case of 90 degree orientation. More elongation will be found in 90 degree orientation. The elongation is less in case of 90 degree orientation. Maximum load at high yield point in case of 90 degree orientation.

Flexural properties: The flexural strength is superior in case of 90 degree fibre orientation. The stiffness property is good at 90 degree orientation. The load at high yield point is maximum at 90 degree orientation. More deflection is found in 30 degree orientation. The deflection is less in case of 90 degree orientation Impact properties Impact strength is superior in case of 90 degree fibre orientation.

EPOXY CARBON FIBRE

Tensile properties: The tensile strength is superior in case of 90 degree orientation. More force is required for fracture of carbon fibre reinforced polymer composite in case of 90 degree orientation. More elongation will be found in 90 degree orientation. The elongation is less in case of 90 degree orientation. Maximum load at high yield point in case of 90 degree orientation.

Flexural properties: The flexural strength is superior in case of 90 degree fibre orientation. The stiffness property is good at 90 degree orientation. The load at high yield point is maximum at 90 degree orientation. More deflection is found in 90 degree orientation. The deflection is less in case of 90 degree orientate

CONCLUSION

The experimental investigations used for the analysis of mechanical properties of Epoxy glass fibre and carbon fibre composites leads to the following conclusions:

- The type of fibre orientation plays a significant role in the determination of the mechanical property of composites.
- The tensile, flexural and tests provides a better understanding of the mechanical behavior of the laminated composites.
- The tensile, flexural and impact strength are superior in case of 90 degree fibre orientation in epoxy glass fibre.
- The fibres with 90 degree orientation could carry more load than the fibres with 0, 30 and 45 degree orientation in epoxy glass fibre.
- The tensile, flexural and impact strength are superior in case of 90 degree fibre orientation in epoxy carbon fibre.
- The fibres with 90 degree orientation could carry more load than the fibres with 0, 30 and 45 degree orientation in carbon fibre.
- Extension deflection is minimum in case of 90 degree orientations and maximum in 30 degree orientations in both epoxy glass fibre and carbon fibre.
- On comparing the epoxy glass fibre and carbon fibre composites the mechanical property are superior in case of carbon fibre laminates with 90 degree fibre orientation.
- This study of glass epoxy and carbon fibre reveals that the glass reinforced composites can be extensively used in aviation, aerospace whereas carbon fibre in automobile industry, medical applications, military and sporting goods.

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