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STUDY ON HYBRID GLASS/CARBON FIBER REINFORCED VINYL ESTER POLYMER COMPOSITES

S. Ravindran[1], M.Balamurugan[2], K.Guru[3], N.Dinesh[4], E.Aravind[5], P.Anand[6]

[1,2]Assistant Professor, Department of Mechanical Engineering, Sri Venkateshwaraa College of Engineering and Technology, Puducherry, India
[3,4,5,6]UG Final Year Students, Department of Mechanical Engineering, Sri Venkateshwaraa College of Engineering and Technology, Puducherry, India

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ABSTRACT:- Over the past three to four decades, the application of composite material is raising from traditional areas to several industrial fields. In advancement to the composite materials, hybrid composite plays a vital role. Hybrid composites has significantly expanded their application in automobile and marine industries in recent years. Hybrid composites are those composites which have a combination of two or more reinforcement fibers. Hybrid composite obtains required properties by choosing different fibers and matrix according to the needs. In this study, the glass fiber and carbon fibers are chosen as the reinforcement and the vinyl ester resin is chosen to be the polymer matrix.

Key Words: Hybrid composite, Glass fiber, Carbon fiber, Vinyl ester resin.

1. INTRODUCTION

A composite is combination of two materials in which one of the materials, called the reinforcing phase, is in the form of fibers, sheets, or particles, and is embedded in the other materials called the matrix phase. Composites typically have a fiber or particle phase that is stiffer and stronger than the continuous matrix phase and serve as the principal load carrying members. The matrix acts as a load transfer medium between fibers. Most commonly used matrix materials are polymeric. Fiber reinforced polymer is a type of polymer matrix composite. Common fiber reinforced composites are composed of fibers and a matrix. Fibers are the reinforcement and the main source of strength while matrix glues all the fibers together in shape and transfers stresses between the reinforcing fibers. Sometimes, filler might be added to smooth the manufacturing process, impact special properties to the composites, and or reduce the product cost. Fiber-reinforced polymer (FRP) composites possess many advantages, e.g., low-weight, high specific strength and specific stiffness, convenience of installation, especially for carbon FRPs (CFRPs).

1.1 Glass Fiber

The Glass fibers, also known commercially as „fiberglass", are most extensively use reinforcements for polymer matrix composites due to their combination of low cost, high strength and relatively low density. Unlike carbon fibers, glass fibers are isotropic thus avoiding loss of properties when loaded in the transverse direction. Fiberglass is produced by pulling molten glass through orifices at a temperature where the glass has just the right amount of viscosity. Its weight properties are also very favorable when compared to metals, and it can be easily formed using molding processes. The woven roving was chosen as one of the fabrics because of its wide use in boat construction and its inexpensive way of applying a large quantity of the glass in one ply.

1.2 Carbon Fiber

Carbon fibers are used in advanced structural composites for aerospace and sporting goods industries. They are characterized by very high stiffness and low density. Some carbon fibers have a stiffness that are ten times and densities that are one half that of glass fibers. Although many carbon fibers have high strength, they are generally not as strong as glass fibers or aramid (Kevlar) fibers. Carbon fibers exhibits very low coefficients of thermal expansion. Carbon fibers are chemically inert and not susceptible to corrosion or oxidation. Carbon fibers are electrically conducting, which is quite advantageous to the aircraft designer who must be concerned with the ability of an aircraft to tolerate lightning strikes. Carbon fibers are also costly when compared to glass fibers. Unlike glass fibers, carbon fibers have very high fatigue strength.

1.3 Vinyl Ester Resin

Vinyl ester (VE) resins are produced from epoxy resins and unsaturated monocarboxylic acids. Their low room temperature viscosity coupled with rapid curing and

relatively low cost make them suitable for various moulding processes. In addition, vinyl ester resins possess high mechanical strength as well as chemical and solvent resistance. The vinyl ester resin is a thermosetting polymer. The vinyl ester has lower resin viscosity than polyester and epoxy. It is a common resin in the marine industry due to its corrosion resistance and ability to withstand water absorption. Vinyl ester resin is extensively used to manufacture FRP tanks and vessels.

2. LITERATURE SURVEY

This part presents a survey of the literature to draw out the foundation of the study, to be carried out in the present work.

1. Effect Of Change In Volume Fraction On Mechanical Properties Of Glass Fiber/Epoxy Resin Composite, Prof. Jagadale Vishal .S, in this study the change in volume fraction of fiber is maintained about 40%, 60%, 50% and the composites are tested to know the mechanical properties. The variation of properties with fiber fraction increases mechanical properties and 50% shows better mechanical properties. However more fiber content causes delamination.

2. Experimental Analysis of Carbon / Glass Fiber Rein Forced Epoxy Hybrid Composite with Different Carbon/Glass Fiber Ratio; Karthick Saravanan. S, Vetrivel. R; this research is done with three different laminate with different carbon/glass fiber properties are fabricated using vacuum bag technique. The tensile strength, flexural strength, & the impact strength increases as the ratio of the carbon fiber reinforcement is increases in the matrix. The strength of laminate also depend on bonding between the fiber and matrix, individual properties of fiber, presence of voids, adopting ideal fabricating process, etc.

3. Processing & Flexual Strength of Carbon Fiber and Glass Fiber Reinforced Epoxy Matrix Hybrid Composite; Prashanth Turla,. Concluded the Hybrid composite (carbon & glass reinforcement composite) provide combination of properties such as tensile strength, compressive strength & impact strength that cannot be realized in normal composite materials. The flexural strength of hybrid composite significantly improved as compared to glass fiber reinforced composite/carbon fiber reinforced composite. With these properties obtained from the hybrid composite, it is clearly suitable for structural applications.

4. The Properties Of Vinyl Ester Composite Reinforced With Different Types of Woven Fabric & Hollow Phenolic Micro Spheres; L Yusriah , M Mariatti and A Abu Baka. This paper describes that the woven fiber have served has stress bearer when composites were subjected to load. The flexural & impact properties of woven glass/ crabon fiber reinforced vinyl ester composite are increased when compared to undirectional fiber composite. The thermal stability of woven fiber reinforced vinyl ester composite was governed mainly by thermal properties of fiber used.

5. Impact Behavior of Glass Fiber Reinforced Composite Laminates at Different Temperature; Amal A.M. Badawy. Fiber orientation & fiber volume fraction are important parameters in the impact characterization of GFRP composite. Increasing fiber volume fraction increased the impact strength for cross poly laminated composites and unidirectional laminated composites.

6. Carbon/Vinyl Ester Composite For Enhanced Performance In Marine Application; Kunigal N. Shivakumar and Gowthaman Swaminathan; This research is done using two different fiber materials are made into composite material with vinyl ester resin using Vacuum Assisted Transfer Molding Method. The glass/carbon composite have a specific tensile strength of atleast 10 times that of steel and specific compression strength at least 4 times than that of steel. Glass/carbon composite are well suited for constructing ship hull structure which are strength critical.

2.1 EFFECT OF FIBER PARAMETERS ON THE MECHANICAL CHARACTERISTICS

Based on the detailed survey of various studies on Hybrid glass/carbon reinforced composites, it is observed that fiber parameters play an major role in determining the mechanical properties of the composite. The major fiber parameters are length, orientation and diameter of the fiber. Long continuous fibers are preferred than short fibers because long fiber provided enhanced impact resistance, low shrinkage, improved surface finish and dimensional stability. Fibers oriented in one direction give very high stiffness and strength along that direction. If the fibers are oriented in more than one direction, such as in a mat, there will be high stiffness and strength in the directions of the fiber orientations. Fibers have various diameters. Thin fibers are preferred than thick fibers. Thin fibers has more flexural strength when compared to thick fibers. This ability of fiber is because thin fibers can bend easily.

3. CONCLUSIONS

With the help of various studies in Hybrid glass/ carbon fiber composites and vinyl ester polymer composites, the following conclusions are reported.

- The hybrid fiber reinforced vinyl ester polymer composite will have increased tensile and impact properties because to combined properties of glass and carbon fiber.
- The woven carbon fiber and glass fiber has the ability to bend without breaking. Thus they will increase the flexural strength of the composite.
- The vinyl ester resin has more bonding ability. So it will bind the glass fiber and carbon fiber tightly together. This reduces the delamination effect of glass and carbon fiber.
- The vinyl ester resin will have ability of low absorption of water. This makes the composite to be more durable.

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