Study of Compressive Strength of a Hybrid Composite of E-Glass, Jute and Granite Filler Material.

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Abstract

Composites are multifunctional material systems which contain characteristics which is not obtainable from any other discrete material. They are made up of cohesive structures made by combining two or more structures in different orientations, compositions and sometimes in various form.

The term hybrid composite refers to the materials which consist of more then two constituents which are at nano level. Basically one of these compounds are organic and inorganic in nature. Hybrid composite materials are different from any other composite materials which are at macroscopic level.

Granite powder, a waste product generated while sizing granite slabs has been posing problems of disposal. The purpose of this study is to make a meaningful utilization of granite powder as the filler in epoxy matrix.

In the present work an attempt has been made to develop a hybrid composite material using Jute and E-glass fiber with Epoxy and granite as filler material using the Hand-Layup technique. The composites have been fabricated by varying the granite-epoxy ratio on weight percentage basis. Mechanical property such as compressive strength was studied by preparing the specimen according to ASTM D 695 standards.

A comparative study of results for three different weight percentage of filler material is obtained and it was found that ply's with 10% granite powder has the maximum compressive strength compared to other weight ratios.

Keywords: **Laminates, Hand lay-up technique, Granite powder, E-Glass, Jute**

I 1.1 INTRODUCTION

The development of composite materials and their related design and manufacturing technologies is one of the most important advances in the history of materials.

Composite material comprise of strong load carrying material (known as reinforcement) imbedded with weaker materials (known as matrix).The primary functions of the matrix are to transfer stresses between the reinforcing fibers/particles and to protect them from mechanical and/or environmental damage whereas the presence of fibers/particles in a composite improves its mechanical properties like tensile strength, flexural strength, impact strength, stiffness etc[1].

The properties of the composites are greatly influenced by the type of reinforcement in the system. Thermoset resins such as epoxy and unsaturated polyester have diversified application in innumerous fields. Epoxy is widely used as a matrix material for making many composites. Combining suitable amounts of other materials allows the inherited properties of the components to contribute to the creation of new materials with adjusted and improved characteristics.

Jute is a long, soft, shiny vegetable fiber that can be spun into coarse, strong threads. Jute is one of the most affordable natural fibers and is second only to cotton in amount produced and variety of uses of vegetable fibers. Jute fibers are composed primarily of the plant materials cellulose and lignin. It falls into the bast fiber category (fiber collected from bast or skin of the plant) along with industrial hemp, flax (linen), ramie, etc. The industrial term for jute fiber is *raw jute*. The fibers are off-white to brown, and 1–4 meters (3–13 feet) long. Jute is also called "the golden fiber" for its color and high cash value.

E-glass is also known as electrically graded glass was basically developed as stand-off insulators for electrical wiring. Later it was found that they have excellent fiber content capabilities and is now used as basic reinforcement material called as fiber glass.

Epoxies are also used in producing fiber-reinforced or composite parts. They are more expensive than polyester resins and vinyl ester resins, but usually produce stronger and more temperature resistant composite parts[3].

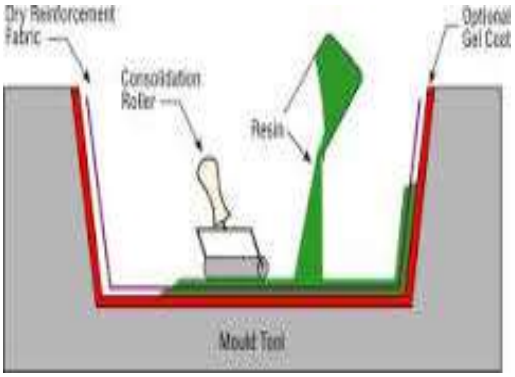

Figure1 Hand Lay -up Technique

Granite powder, a byproduct obtained during the sizing of granite stones by processing granite slabs has no end use. In the work granite powder is used as the reinforcement to the matrix system to prepare composites[4].

The composite material used in this research was manufactured using plain weave mat of E-glass fabrics of 0.3mm thickness as synthetic reinforcement. Jute fibers were used as natural reinforcement. The matrix material was Epoxy.

2 CompositeManufacturingMethod.

There are many techniques available in industries for manufacturing of composites such as compression molding, vacuum molding, pultruding etc. The hand lay-up process of manufacturing is one of the simplest and easiest methods for manufacturing composites. A primary advantage of the hand lay-up technique is to fabricate very large, complex parts with reduced manufacturing times. All composite specimens were manufactured using hand lay-up process.

The prepared material is shown in Fig2.

Fig 2 Finished material of hybrid composite.

2.1 Epoxy Resin

This is the end product of epoxy resins. It is used as an adhesive material in fibre reinforced plastics. Generally two resins are used to mix together before use. This can be used solver since its melting and boiling points are high respectively.

Fig 3 Epoxy Lapox L12

2.2 Hardener

Epoxy resins are cured with the addition of curing agent it is commonly used as hardening agent which is called as hardener. This is added in terms of 1:10 ratio to the weight of epoxy.

Figure 4 Hardener K-6

(Lapox L12) resin and hardener(K6) was supplied by Atul Ltd Valsad Gujarat India.

2.1 Experimental Procedure and Apparatus.

All experimental tests were carried out at Composite technology park (CTP) Bangalore India.

2.1.1 Compression Test

Compressive strength is a key value for design of structures. Compressive strength is often measured on a universal testing machine; these range from very small table-top systems to ones with over 53 MN capacity Measurements of compressive strength are affected by the specific test method and conditions of measurement. The compression strength of the composite depends on the type of fibre used and increases with the amount of fibre.

Fig5Universal Testing Machine(Compression)

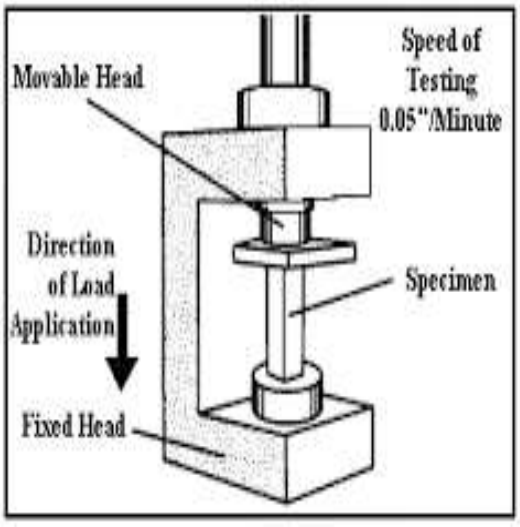

Fig 6 Compression test procedure

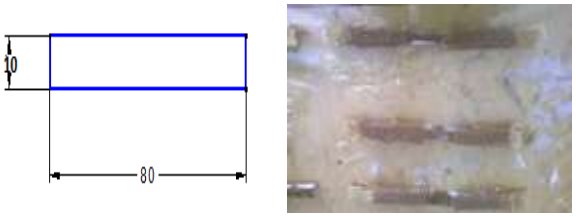

Figure 7 Compression Test specimen

Composite specimens of dimensions (80 × 10×6)mm were horizontally placed on two supports and load was applied at the centre. Compressive test is also performed in Universal testing machine as per ASTM D695 with additional ribs for the support.

3 Results And Discussions

All experimental tests were repeated three times to generate the data.

Sl No	Percentage of Granite Powder	Compressive Strength MPa
1	0%	20.34
2	5%	44.06
3	10%	57.29
4	15%	49.75

Table1Shows the experimental results for testing of the material

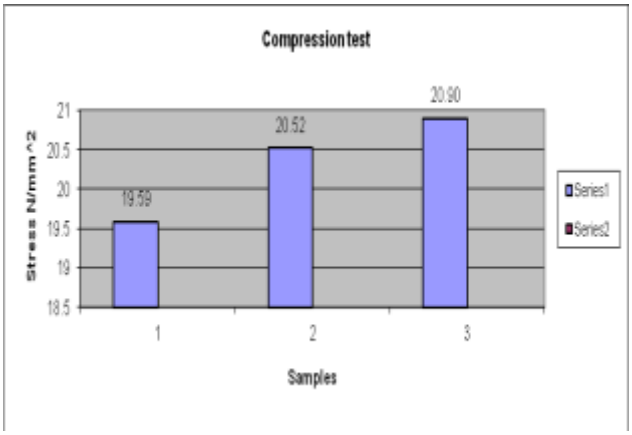

Figure 8 Compressive strength (Mpa)for 0% granite powder.

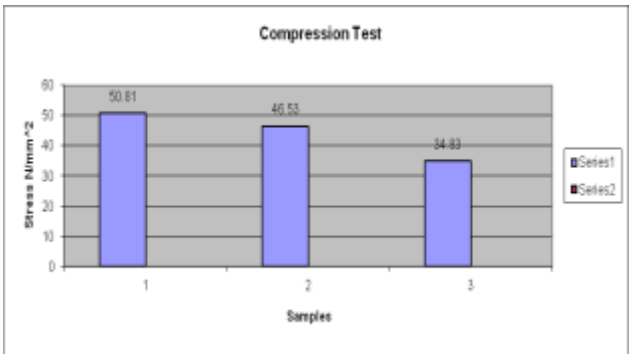

Figure 9 Compressive strength (Mpa) for 5% granite orientations

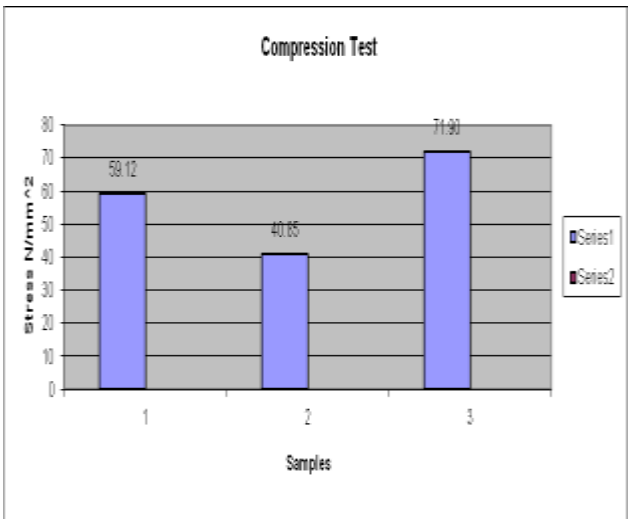

Figure 10 Compressive strength (Mpa) for 10% granite powder

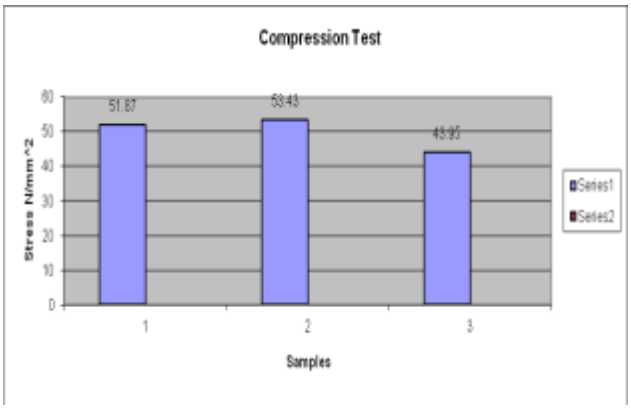

Figure 11 Compressive strength (Mpa) for 15% granite powder

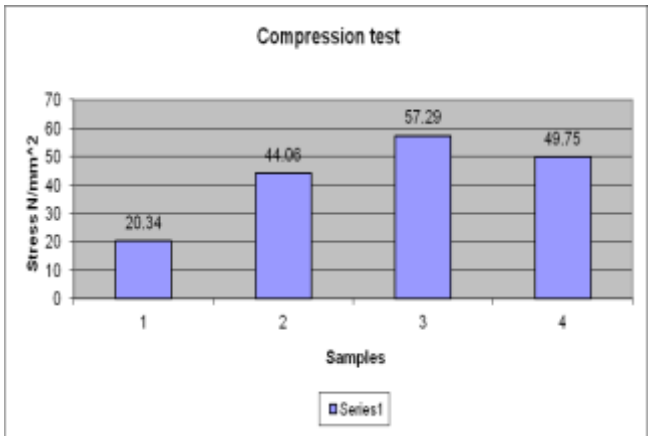

Figure 12 Overall compression strength (Mpa) for different percentage of granite powder

Conclusion

A comparative study of results for three different weight percentage of filler material is obtained and it was found that ply's with 10% granite powder has the maximum compressive strength compared to other weight ratios.

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