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Study of Wear Analysis 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 than 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 wear factor 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 5% granite powder has the minimum wear factor compared to other weight ratios and with 15% granite powder has the maximum wear factor compared to other weight ratios.**

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

I. 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. 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]. 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.

II. COMPOSITE MANUFACTURING METHOD.

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.

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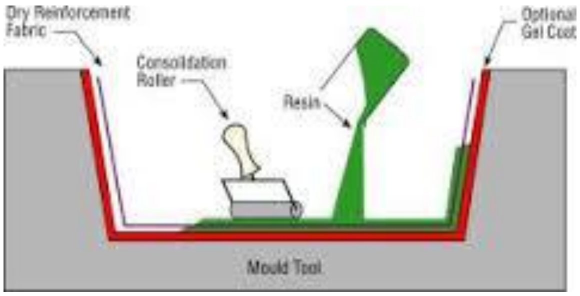

Figure1 Hand Lay -up Technique

The prepared material is shown in Fig2.

2.1 Epoxy Resin

This is the end product of epoxy resins. It is used as an adhesive material in fiber 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 2 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 3 Hardener K-6

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

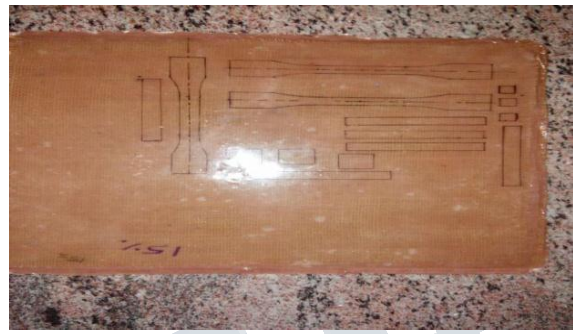

Fig 4 Finished material of hybrid composite.

2.1 Experimental Procedure and Apparatus.

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

2.1.1 Wear Test

WEAR:-

Wear is related to interactions between surfaces and specifically the removal and deformation of material on a surface as a result of mechanical action of the opposite surface.

In materials science, wear is erosion or sideways displacement of material from its "derivative" and original position on a solid surface performed by the action of another surface

WEAR MEASUREMENT:-

Wear measurement is carried out to determine the amount of materials removed (or worn away) after a wear test, (and in reality after a part in service for a period of time). The material worn away can be expressed either as weight (mass) loss, volume loss, or linear dimension change depending on the purpose of the test, the type of wear, the geometry and size of the test specimens, and sometimes on the availability of a measurement facility.

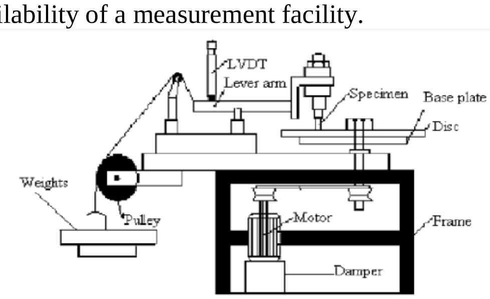

Fig 5 Wear Testing Machine.

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III. RESULTS AND DISCUSSIONS

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

0% Filler Material:

Load	10 N		20 N		30 N	
Time	15	30	15	30	15	30
Wear Factor *10^-8	0.2366	3.9317	7.8634	1.9658	3.5298	3.4948

Table1: Shows the experimental results for testing of the Composite material with 0% filler material.

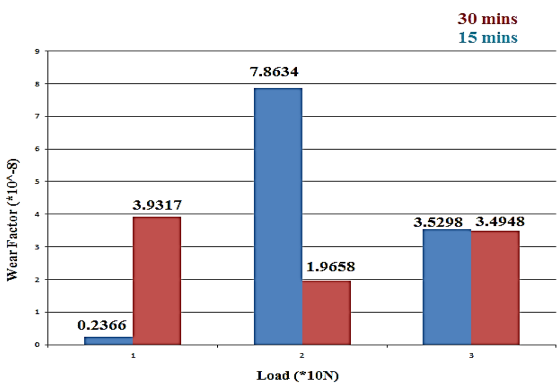

Fig 6 Wear Factors for the composite material with 0% filler material.

5% Filler Material:

Load	10 N		20 N		30 N	
Time	15	30	15	30	15	30
Wear Factor *10^-8	7.8634	2.6605	3.9317	5.8975	3.4948	2.6211

Table2: Shows the experimental results for testing of the Composite material with 5% filler material.

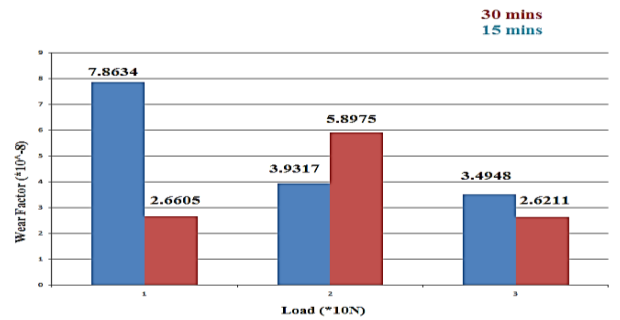

Fig 7 Wear Factors for the composite material with 5% filler material.

10% Filler Material:

Load	10 N		20 N		30 N	
Time	15	30	15	30	15	30
Wear Factor *10^-8	0	2.6211	5.2423	5.2423	4.3686	2.6211

Table3: Shows the experimental results for testing of the Composite material with 10% filler material.

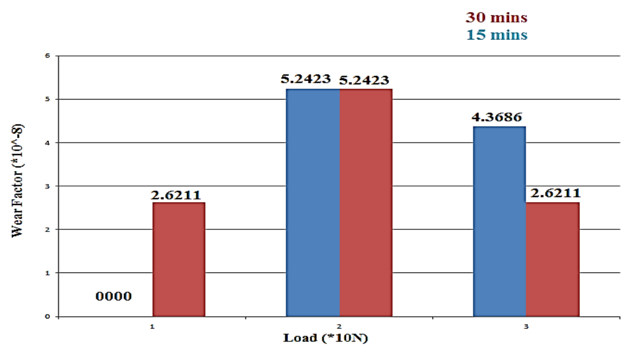

Fig 8 Wear Factors for the composite material with 10% filler material.

15% Filler Material:

Load	10 N		20 N		30 N	
Time	15	30	15	30	15	30
Wear Factor *10^-8	2.6211	3.9317	3.9710	3.2764	6.9897	3.9317

Table4: Shows the experimental results for testing of the Composite material with 15% filler material.

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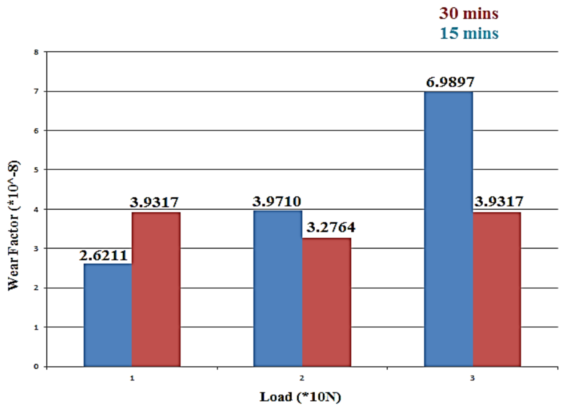

Fig 9 Wear Factors for the composite material with 15% filler material.

From the above results it is found that for the reinforcing of 5% of filler material(granite powder) to the matrix material has very low wear rate under the experimental conditions of the maximum load of 30N and maximum duration of 30 minutes, at the maximum speed of 300rpm. From the above results it is found that for the reinforcing of 15% of filler material(granite powder) to the matrix material has high wear rate under the experimental conditions of the minimum load of 10N and maximum duration of 30 minutes, at the maximum speed of 300rpm.

IV. CONCLUSION

From the above results we can conclude that on reinforcing 5% to 10% of the filler material (granite powder) to the matrix material gives the minimum wear rate for the maximum duration (30 minutes) and for the maximum speed (300 rpm).

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