A STUDY OF FIBERGLASS MATERIAL WITH DIFFERENT COMPOSITIONS

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ABSTRACT *This Due to increasing demand and widespread application of Fiberglass composites, they have been used in a variety of application like aerospace, automotive, sports, ships and constructional work. Because of their several advantages such as relatively low cost of production light weight, easy to fabricate and superior strength to weight ratio. In the present work E-glass fiber is used as reinforcing agent with and without alumina filler. The objective of the present research work is to study the mechanical and abrasive wear behavior of coated and uncoated E-glass fiber reinforced epoxy based composites. The effect of fiber loading and filler content on mechanical properties like hardness, tensile strength, flexural strength and impact strength of composites are studied. A robust design technique called Taguchi method is also used to determine the optimal condition for specific wear rate of the composites by considering different parameters. A study is also performed to study the effect of various factors on the sliding wear behavior of the composites. Surface morphology of composites was studied by optical microscope.*

Keywords:

1. INTRODUCTION:

When dissimilar composition with divergent properties from each other mixed together, or a system fabricated from 2 or a lot of physically dissimilar phases by a distinct interface whose mixing produces versatile properties that are in higher grade in different ways, to its every material.

Composite materials are very versatile and are utilized in a variety of applications. Composite parts gives good strength and structure become lighted weighted and can be molded in any. Main application of fiberglass is to make cover and sheet. It mainly uses in automobile Industry, aerospace industry etc. Generally fiberglass is used with polyester resin to make it Fiberglass sheets.

The combination of materials having totally different properties, or a system constituting of 2 or additional phases separated by a distinct platform whose mixture results in production of summed up properties that square measure outstanding in several ways that, to its individual composition. The enhanced properties can be obtained by combining the different materials and then getting the resultant material.

On combining the materials, 2 constituent's specifically primary constituent and also the epoxy. The system that is continuous in nature and is gift in larger amount is known as primary constituent. The primary constituent holds and binds the fiber together, distributes the load uniformly within the fibers, and also protects it from mechanical and environmental disaster. While the second constituent is known as reinforcement and it is use to increase the mechanical properties like the stiffness and strength of the material etc.

As we know fiberglass is a special type of synthetic fiber. Its strength is generally greater than other fibers the main property of fiberglass is that it is fireproof, waterproof and today used in fabrication of body of the sports cars.

2. METHDOLOGY:

2.1 Material

2.1.1 Primary Constituent

The most commonly used material is polymer matrices and it have following advantages like it have easily available, its cost is low, can be moulded to any shape and size that is it is

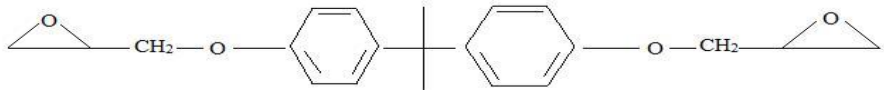

Figure 2.1 Ly-556

easily fabricated, most important property of the material is that it have light weight to body ratio that its overall weight is very less as compared to the other material. The primary constituent that area unit utilized

in gift paper work is fiberglass epoxy that be the category of thermosetting material which will contain epoxide cluster as it main function is that it will be bonded to the one oxygen atom by two carbon atom.

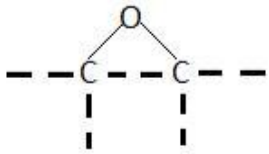

Figure 2.2 The epoxy

As compare to the other resin of thermo set epoxy resin is used in many industrial application due to its various advantages as it forms the 3-dimensional cross-link compound that undergoes the chemical reaction that is irreversible in manner. While comparing with the thermo set resin it shows the superior quality to that of it like it higher mechanical strength, bonding between the molecules of secondary constituent is very good that is fiber of both the compound are tightly attached, it have higher resistant to chemical reaction and it have lower shrinkage ratio therefore we choose the epoxy resin LY-556 as it have all the quality that we need to bind the fiberglass with our secondary constituent.

2.1.2 Fiber Material

Fiberglass is most commonly used reinforcing agent among various amalgamated material. Fiberglass is available in the various forms like woven fabric, non-ending fiber, chopped fiber and short discontinuous fiber. In this work fiberglass is used because the reinforcing agent because it have the length of fiber concerning 6mm it contains the salt glass which will contain alkali chemical compound of but 1 Chronicles.

Figure 2.3 Fiberglass of 6mm length

2.1.3 Filler Material

As per the study it can be conclude that various constituent are used because the filler material in chemical compound composite usually ar Silica carbide (SiC), Titania (TiO2) are wide used as a standard filler material. during this work we have a tendency to take aluminum as a filler material as it various advantages that is its property related to mechanical, chemical and physical is very good like it have strength, light weight, high hardness and low cost which made it the right filler material to be used that enhance the properties of the reinforcing constituent.

2.2 Fabrication

2.2.1 Mechanical Testing

In the present work we take fiberglass as the reinforcing agent epoxy and the Aluminium filler material which have a particle size of 80 to 100 µm and it done by filing the Aluminium bar to make it powder of size lower than that of fiberglass so it can easily can be mixed with it if we take lager particle of the Aluminium filler so it make it difficult to bind with the fiberglass therefore fine particle size is used to make the bonding good. First of all fiberglass is taken in the mould then layer of Aluminium filler material is sprinkled over it no another layer of fiberglass is spread over it now epoxy is poured into it now the mould is prepared so that a pressure can be applied to the composite to make the sheet out of it. A pressure of 25kg is applied on it at a temperature of 270^0C so that the Aluminium filler is mixed thoroughly and bind with the particles of the fiberglass. Two samples are made one is with filler material and other is without filler material so that we can compare the value of both the specimen while testing. The quantity of filler material may vary in different samples so that we can conclude that which sample have good strength and surface quality and it can be overcome by all the test i.e. it have superior quality. Now when the material is set is is then cut to the required shape and size so that various test can be performed on it.

2.2.2Wear Test

In wear test a different sample were prepared by using a plastic tube having diameter 20mm and length 100mm. Filler material that is Aluminium and the reinforcing agent remain the same as above and the condition is also favourable as that of above.

2.2.3 Coating of filler on the Composite

A technique called thermal evaporation can be used to melt or to vaporize the Aluminium filler so that it can be easily deposited on the reinforcing agent by placing it in the evacuated chamber so that a gaseous stated can be attained. The Aluminium vapour formed fills the entire gap that is present inside the particles of the fiberglass to make a compound. But in this technique the deposition rate of Aluminium is typical that (~8nm/s). On the other hand Aluminium is suitable for evaporation because they can be melt at crucible condition and produces high quantity of vapour. But this work represent the coating of the Aluminium filler which can be pressurized and heated upto certain temperature so that it can form the Amalgamation of material that cannot break easily. As we increased the temperature of the filler material it melt and try to mix out with the fiberglass that substrate.

(Ts<<T)

Where, Ts = Temperature of the substrate T = Temperature source

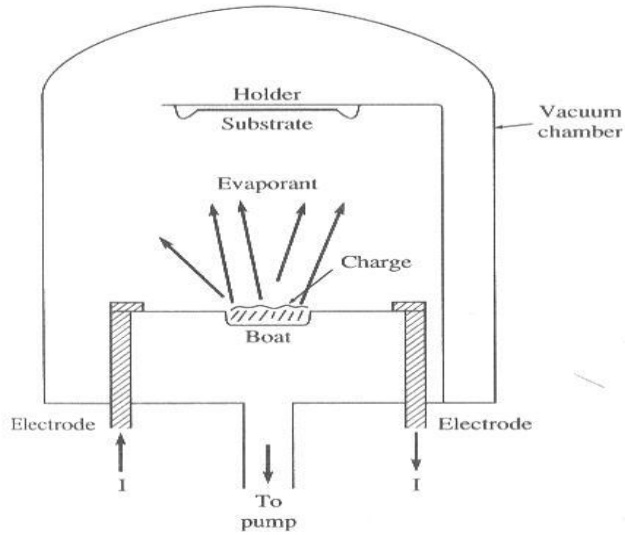

Figure 2.2.1 Vacuum evaporation system

Table 2.1 Samples of Composites

Composite	Composition
Sample1	Fiberglass (80 wt. %)+ Alumina (5 wt. %)
Sample 2	Fiberglass (70 wt. %)+ Alumina (15 wt. %)
Sample 3	Fiberglass (80 wt. %) + epoxy without filler material
Sample 4	Fiberglass (70 wt. %) + epoxy

2.4 Mechanical Testing

Various test are performed on different machines like Hardness is performed on Brinell Hardness test, Tensile test is performed on Universal testing machine and Toughness test is performed on Impact testing machine as well as surface roughness is checked by Optical microscope.

3. RESULT AND DISCUSSION

The physical properties of composites Table 3.1 shows the identical and measured density of the samples of composites. The variations in densities area unit} the measure of voids gift in composite samples.

S.No	Filler (%)	Theoretical density (gm/cc)	Measured density (gm/cc)	Void Fraction (%)
1	0	1.215	1.056	10.32
2	0	1.5216	1.1033	6.68

3	0	1.52532	1.283	5.76
4	0	1.5292	1.2	7.548
5	4	1.52643	1.22	3.19
6	4	1.63035	1.3	4.541
7	4	1.4345	1.35	2.18

Table 3.1 Densities with void fractions in composites.

3.2 The Mechanical properties of fiberglass without filler at different fiberglass loading

Composites	Hard (property) (HV)	Flexural property (MPa)	Tensile property (Mpa)	Impact property (J)
1	19.7	18.41	5.62	0.445
2	24.85	53.5	12.23	4.433
3	24.54	64.2	16.3	3.628
4	25.54	49.3	15.36	4.82

Table 3.2 Mechanical properties of fiberglass without filler at different loading

3.2.2 The Mechanical properties of fiberglass with filler at different fiber loading

Table 3.3 shows the mechanical properties of the fiberglass at different fiber loading. It is analysed form previous results that the composites with approx. 10wt% of fibre loading with approx. 5 wt.% of corundomi.e.1 shows higher flexural and impact strength as compared to others composites. On the opposite hand higher hardness and high strength is exhibited by the three and a couple of composites.

Composites	Hard-ness (HV)	Flexural property (MPa)	Tensile property (MPa)	Impact property (J)
1	26.34	74.4	27.19	3.156
2	30.62	34.65	35.55	2.01
3	36.28	68.2	24.83	1.577

Table 3.3 Mechanical properties of fiberglass with filler at different fibre loading

3.3 The Surface morphology of composites before and after tensile test

Figure 3.3.1 (a) shows the fibre glass reinforced composites before they're seasoned to tensile take a look at. This shows the uniform distribution of fiber in matrix, presence of voids and therefore the tiny patches that indicates the presence of filler within the matrix. Once uniaxial tensile load is applied, the matrix gets forced the lock layers; crack travels through the matrix wherever the fibre distribution is non uniform i.e. from the weakest section of composite that causes localized yielding. Presence of fibres prevents the formation of cracks, however once applied load reaches on top of the yield purpose of the fabric then fibre-Matrix bonding wasn't enough to require the applied load and it finally breaks down that is shown in Figure three.three.one(b).

Figure 3.3.1 (a) Optical microscope images of fiberglass before tensile test

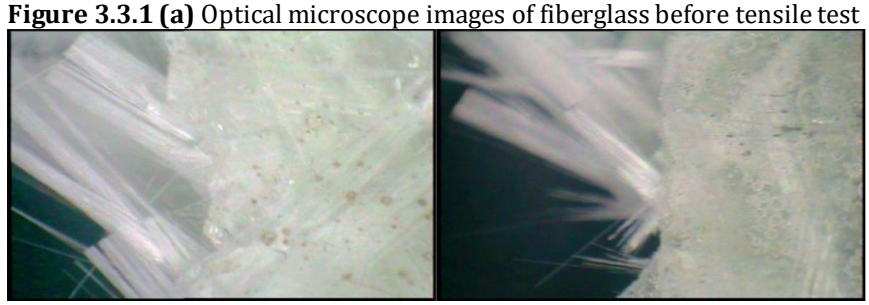

Figure 3.3.1 (b) Optical microscope images of Fiberglass after tensile test

3.4 Wear behaviour of fiberglass composites

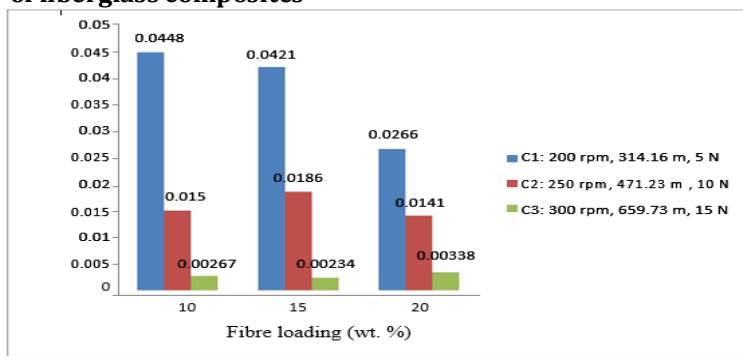

Figure 3.4.1 Wear rate of filler and without filler composites at different loading conditions.

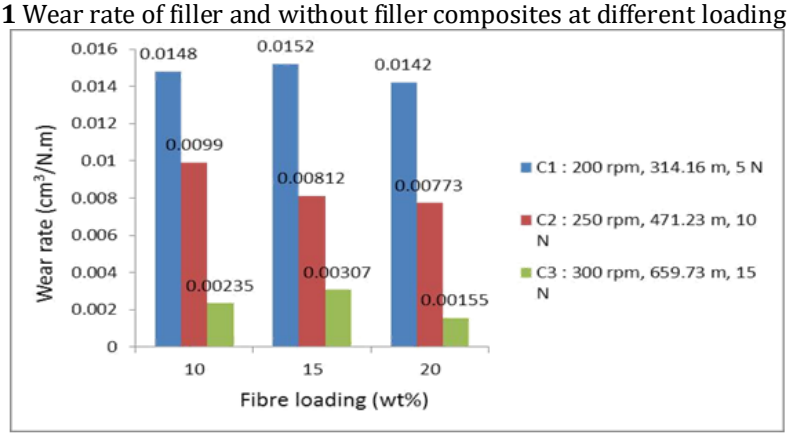

Figure 3.4.2 Wear rate of composite coated and without filler material

4. CONCLUSION

The work done is based on the experimental result on fiberglass that will be loaded at different condition with or without the filler material and various mechanical test will be performed on the specimens to check the various properties at different stages so it will lead to the following conclusions form present work are as follows.

- Fabrication of the fiberglass with different composite is done by pressurised method.
- Fiberglass is coated with the Aluminium and the thickness of coating is not much than that of 0.30 µm as it will lead to the removal of the filler material in the form chips and coating is done by the thermal evaporation technique that make it one material.

- When an additive is used in term of filler material called Aluminium it enhance the property of the fiberglass resin besides this it will improve the hardness, toughness and tensile strength of the fabric. On the opposite hand Impact strength and flexure strength of the fabric is additionally improved by addition of the filler content.
- It can be noted that there is vast change in the properties of the material before and after the filler content like hardness, flexural and tensile properties.
- The main aim of the mixing of the filler material is to enhance the wear properties of the fiberglass composites. As the fiberglass that contain the filler material have less wear rate than that of the material that not contain the filler material Al_2O_3.
- The study show that Aluminium filler, thickness of the coating, sliding distance and the loading condition has a vital role on the effect on the wear rate of the fibreglass composites.

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