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Evolution of glass finished finer materials using copper powder

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ABSTRACT

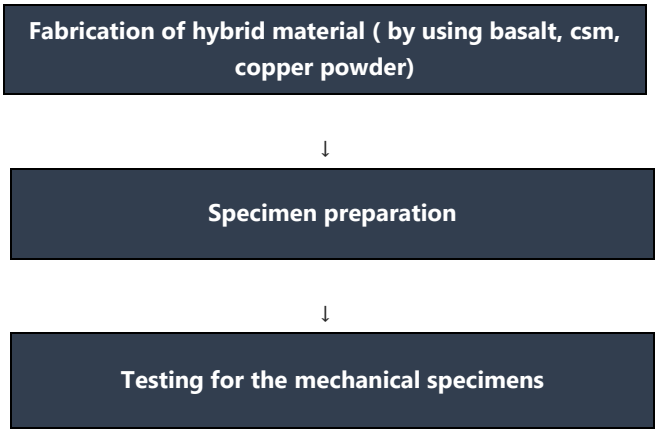
The present work deals about composite rocks in which basalt has emerged as a contender in the fiber reinforcement of composites. This examination is directed to execution of copper powder as fine aggregate reinforced basalt fiber and chopped strand mat with suitable dosage of copper powder by mixing of resin hardener. The results revealed at 10% copper powder hybrid composite showed maximum in hardness and vibration strength.

Key words: Basalt rock, fiber, non-metallic, chopped strand mat, Vibration test

1. INTRODUCTION

The main purpose of the paper is to know the Hybrid composition with respect of basalt and chopped strand mat by adding of copper powder is to mainly review the strength of the material. So according to the results the basalt material is having highest tensile strength and by adding copper powder to hybrid material it shows the good result at some accuracy [1]. Here it is the review of the materials which are taken in the project. In many designing applications, half and half composite materials are generally utilized, as they convey a scope of improved properties and particular points of interest over traditional composite material [2]. The

procedure is really less difficult than glass fiber handling in light of the fact that the basalt fiber has a less perplexing structure but the procedure requires just a solitary feed line to arrive at its creation state [3]. Basalt fiber is a material produced using incredibly fine molten rocks which comprises of plagioclase, pyroxene, and olivine minerals [4]. It is used as surfacing and filling in roads, the floor tiles in the construction and is the lining material in the pipes for transporting the hot fluids [5]. Chopped strand mat is a type of fiberglass reinforcement. It consists of glass fibers randomly spread across and held together by a binder where sheets of material are placed on a mold and brushed with resin [6]. It is very comfortable to work with, since it can be stretched and can take all sorts of complex shapes because of the impregnation with the resin and the emulsion binder produces superior handling properties compared to powder bonded mats [7]. The term filler is very broad and involves a very wide variety of materials that play an important role in improving composite performance. Filler materials are used to minimize production costs, to improve the mechanical properties to some degree and in other cases to enhance process capability [8]. All these resins are thermosets, which vary in their chemical make-up, thus exhibiting various properties. This means that manufacturers can select resins that allow them to adapt their products to different requirements [9]. The composite panels were fabricated by hand lay-up process and this fabrication process is done on a clear glass film [10]. So after the event of half and half material with air i.e. basalt, chopped strand mat join with copper powder it gives a glass completed substance. Due to previously mentioned cross breed materials and there properties the stream diagram of strategy was spoken to as beneath.



The flow chart is showing the hand lay-up process it is the most common and least expensive open-molding method because it requires the least amount of equipment suitable for making a wide variety of composites products from very small to very large production. Here the fibre mats are placed by hand then wet with resin on polythene sheet to allow for ideal processing condition. In order to specify any hybrid material, we must have a quantitative description of the proportions of the constituents it contains. The relative proportions of basalt and chopped strand mat have a significant influence on the mechanical properties of composite lamina of composition is showing in below table.

Table 1 Designation and composition of composites used in present work	
BRF (basalt rock fibre)	BASALT+Ly556+Hy951
GF (glass fibre)	CSM+Ly556+Hy951
BRF+GF(Hybrid1)	BASALT+CSM+Ly556+Hy951
BRF+GF(Hybrid2)	BASALT+CSM+5gm Copperpowder+Ly556+Hy951
BRF+GF(Hybrid3)	BASALT+CSM+10gm Copperpowder+Ly556+Hy951
BRF+GF(Hybrid4)	BASALT+CSM+15g m Copperpowder+Ly556+Hy951

The table shows the assignment of the creation of the half and half material of their successful properties of the mix. It additionally speaks to the arrangement of the fragmented structures, which were framed after the fulfillment of the hand lay-up process. The accompanying system was done in technique.

2. METHODOLOGY

Basalt and chopped strand mats and cut them into pieces of dimensions Firstly, for preparing of composite we require 6 pieces of basalt mats, chopped strand mat, resin and filler materials like copper powder. On the glass film first apply the epoxy mixture according to the requirement. On the resin place 1 piece of basalt apply resin and then place again basalt mat and apply resin on the mat. Continue for 5 layers to be placed one on another. Now take 5 gm of copper powder and mix it well in resin apply to the basalt and apply to the CSM and place it layer by layer alternatively Continue the same procedure for all the proportions 5%, 10%, 15% of filler material. Continue the same hand lay-up process as we did for Chopper and Basalt composite. Allow the specimens to dry for about 24 hours and take out from the clear glass film. Now cut the specimens into required shaped according to the testings for getting the results using required machinery equipment.

Figure 2 Weighing of copper powder used for hybrid material

Figure 3 Mixing of copper powder in resin

Figure 4 Applying of filler material on the fibre mat

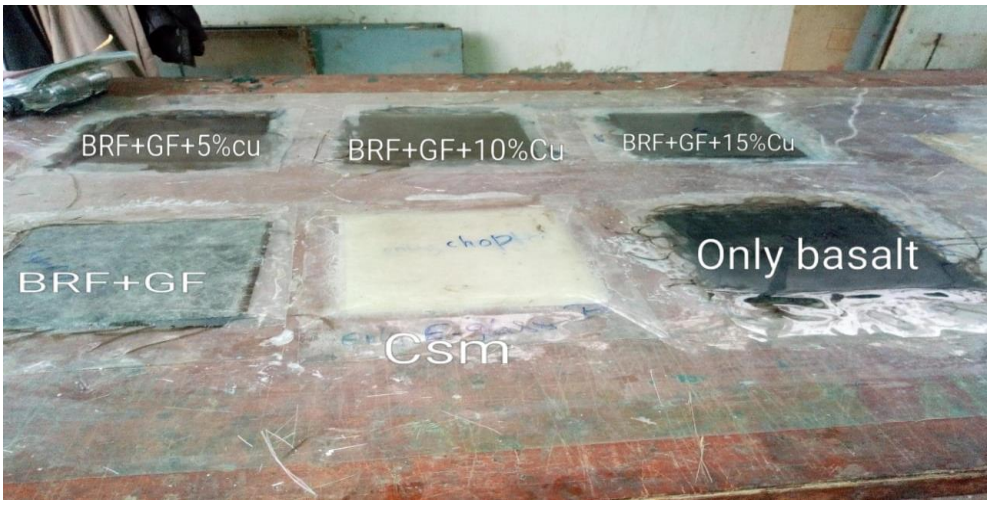


Figure 5 Completion of mats

After the Fabrication the specimens was cut into required piece and the follow test were conducted

- Tensile test
- Hardness test
- Vibration test

2.1. Tensile Test

The fabricated hybrid specimen was cut to the desired dimensions of 200 mm length and width is 10 mm according to ASTM E8/E8M-15A. As shown in figure the tensile strength has been tested on the Universal testing machine (UTM).

Figure 6 Fixing of specimen is ASTM

Figure7 Specimens after failure

2.2. Hardness test

Fabricated hybrid specimen was cut in the dimensions of 30 mm as shown in figure for hardness test. The hardness test was conducted in hardness testing machine. The load applied was 180.5 kgf on the specimen and the holding was 10 seconds. Hardness is defined as the ability to oppose to indentation, which is obtained by measuring the stable depth of the indentation.

Figure 8 Specimen under observation

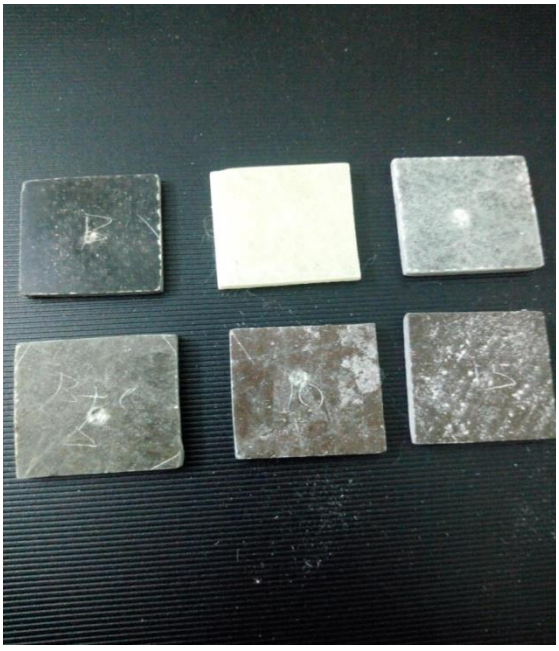


Figure 9 Specimens after load applied

2.3. Vibration Testing

The manufactured specimens were taken in the components of 200 mm length for vibration testing Therefore accelerometer is to be fixed at the spot set apart on the cantilever bar and mallet both to be associated with the channel in the wake of hitting the frequencies are been happened.

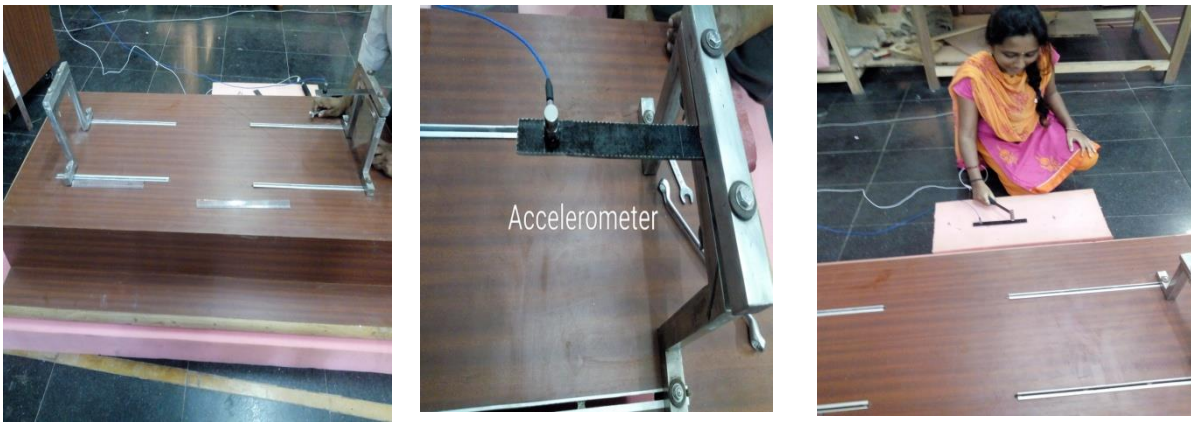


Figure 8 Vibration testing on cantilever beam

3. RESULTS AND DISCUSSION

The mats are prepared and after removing the glass thin sheet the mats were cut into required pieces for several tests like tensile, hardness and vibration. The testing results show that the difference between the frequency and the value of the tensile is increasing with the dosage of copper powder of 15% cu in decreasing in its value in vibration test so the 10%cu have taken the optimized value.

Table 2 Properties of the tensile strength

Property (unit)	CSM	Basalt	hybrid	Hybrid+5 % cu	Hybrid+10 % cu	Hybrid+15 % cu
Load at yield (KN)	5.38	5.8	8.2	8.96	8.1	5.42
Elongation at yield (mm)	0.360	0.560	3.250	2.870	3.620	0.140
Yield stress (N/mm$^{2)}$	179.333	193.333	273.333	298.667	270.00	180.667
Load at peak (KN)	10.100	13.840	10.260	11.240	10.140	11.260
Elongation at peak (mm)	8.420	6.010	5.360	4.960	5.350	5.420
Tensile strength (N/mm$^{2)}$	298.667	342.333	364.000	368.07	375.000	461.000
Load at break (KN)	5.180	5.240	5.140	5.240	5.180	5.180
Elongation at break (mm)	8.400	5.050	5.880	4.810	5.220	5.180

Inference: For the tensile strength the value is increasing by its dosage value of copper powder of 15% of the material so as to accumulate it as per standards it has been tested for hardness and vibration method to find the correct variation of the material.

Table 3 Effect of hardness on hybrid materials

Specimens conducted	Hardness values (HRC)
Basalt	70
Chopped strand mat(CSM)	89
Basalt+ csm(Hybrid)	91
Hybrid+5% Copper powder	98
Hybrid+10% Copper powder	115
Hybrid+15% Copper powder	111

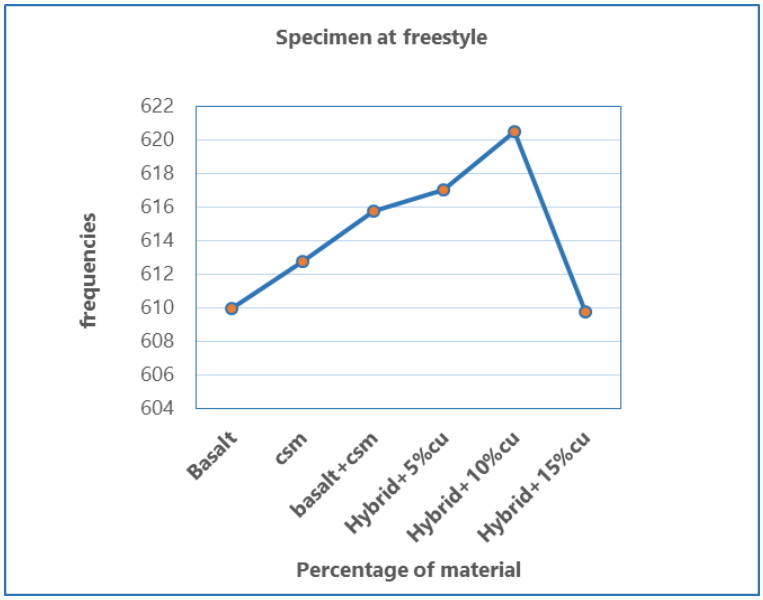
***Inference*:** The effect of Hardness of the hybrid material is also increased but at the percentage of filler material at 15% of copper powder is decreasing so as to know the variation of certain accuracy vibration test is done for the following specimen.

3.1. Vibration Test

The vibration test is conducted for the test specimens to find the frequencies in which the test is conducted in three ways so we can compare the best result for he specimen

- Fix the specimen which is 200mm length in the equipment adjust to its centre tighten under it so it can't move to other position.
- The accelerometer is to be connected to data acquisition system and it is to be fixed on the specimen at the free end.
- So after fixing the specimen hit slowly on the places which are taken 5mm on first and second place through 20 seconds of time so the peak will form on the data acquisition system
- After the completion of testing continue it under freestyle and the hammer is to be hit once on the specimen.
- The peak will form on the data acquisition system show in FFT CH2 the frequencies are to be noted according to the specimen.

Table 4 vibration test at freestyle	
SPECIMENS	**FREQUENCIES (Hz)**
Basalt	609.938
Csm	612.750
Hybrid (basalt+csm)	615.750
Hybrid+5% cu	617.000
Hybrid+10% cu	620.469
Hybrid+15% cu	609.750

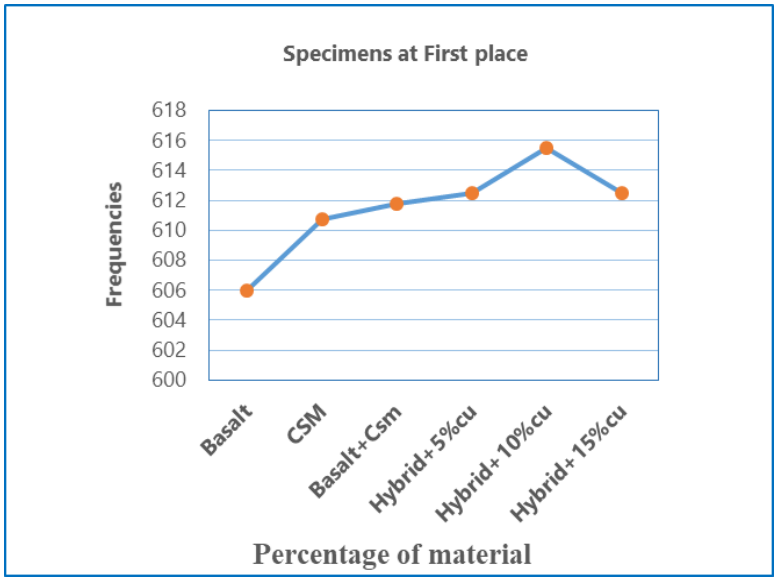


Graph 1 showing the effect of percentage of material at freestyle

Inference: The above graph of the specimen at freestyle is having high frequency at 10 g of cu of 620.469Hz.

Table 5 Vibration test at first place of beam	
SPECIMENS	**FREQUENCIES (Hz)**
Basalt	605.938
Csm	610.75
Hybrid (basalt+csm)	611.75
Hybrid+5% cu	612.500

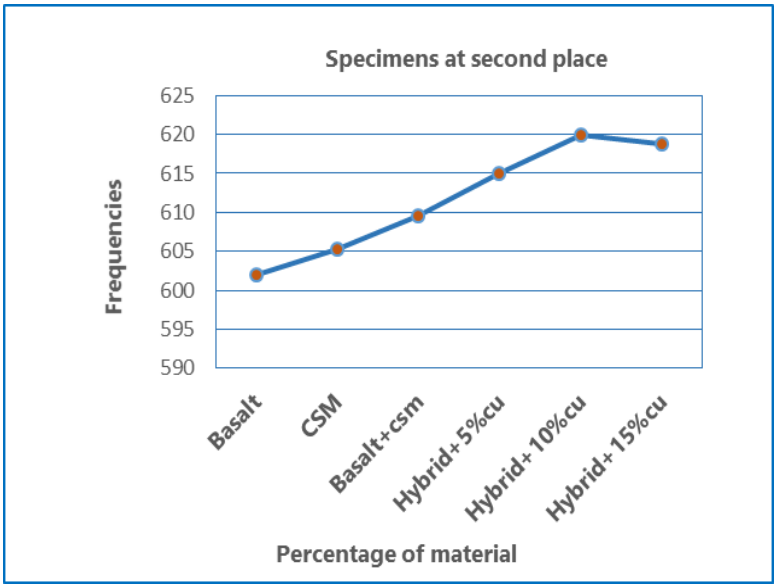
Hybrid+10% cu	615.469
Hybrid+15% cu	612.500



Graph 2 Effect of percentage of material at first place of beam

Inference: The above graph of the specimen at first place of the beam is having high frequency at 10 g of cu of 615.469Hz. as compare to freestyle it is having less frequency due to position changing.

Table 6 Vibration test at second place of beam	
SPECIMENS	**FREQUENCIES (Hz)**
Basalt	602.000
Csm	605.360
Hybrid (basalt+csm)	609.560
Hybrid+5% cu	615.000
Hybrid+10% cu	620.000
Hybrid+15% cu	618.750



Graph 3 Effect of percentage of material at second place of beam

Inference: From the above criteria, the results are showing difference between the frequencies but the best result is found at Basalt + Chopper +10% of Copper powder has good strength. And the error occurred at hybrid (basalt+ csm) +15% cu so therefore we can conclude that the effect of strength increases according to its value and at 10% cu we have taken it for optimized value.

4. CONCLUSION

- Based on above investigation of different mixes utilized in specimen made with Basalt, chopped strand mat, copper powder with different forms of dosage value upto 15%copper powder. Specimens which have been taken tested experimentally for tensile, hardness, and vibration test etc.
- So it can be further tested for dynamic conditions. The study explains about the mechanical properties. So there is a lot of scope to find other properties of hybrid composite.
- It is noticed that the tensile test is having high result in increasing by its value and the composite having Basalt + Csm +10% of Copper powder has the high mechanical properties.
- Generally all the works reported in basalt for construction applications based on that papers it declares that new hybrid material with respect to copper powder for glass finishing object.
- However, the research work can be extended further by considering other methods of composite fabrication and the effect of manufacturing techniques on the performance of composites can similarly be analyzed.

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Conflicts of Interest

The author declares no conflict of interest.

Data and materials availability

All data associated with this study are present in the paper.

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