

INVESTIGATION ON TRIBOLOGY PROPERTIES OF BAMBOO ASH-SILICON CARBIDE REINFORCED HYBRID MATERIAL

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Abstract - As a result of rising cost and toxic material of plastic materials, it has become necessary to search for the affordable and cheaply obtainable material which might be partially replaced. Each year ten million of tons of bamboo is utilized commercially, generating a vast amount of waste. One solution to activate this waste by burning it at optimal condition and using it is additive in concrete to keep it of landfills and save money on waste disposal.

1. INTRODUCTION

Car industry plays an important role as the backbone for the economy of any country. Dashboard is one of the main parts of the car interior component and plays an important role in different aspects such as reliability, safety, technology, user friendly and appearance and so on. Dashboard used for operating different functions in the car such as instrumental panel, audio and video devices, holders, switches and glove box, these functions distributed inside a vehicle that communicate with each other. Car dashboard like the other components of the car have lots of improvement in terms of quality, extra features, material, updating the existing product to take the dashboard at the new level, the car dashboard was designed basically from cheap material and with limited features, but now we can see that modern design and more features is very basic requirement for any type of car.

Here we Replace the Automotive car dashboard and door material from FRP (Fiber Reinforced Product) to natural fiber. Natural material like bamboo ash and silicon carbide reinforced material. It is found that there is a good improvement in ultimate tensile strength, hardness and wear properties with the fraction of reinforcements of **SiC and Bamboo Ash**. Silicon Carbide is an important non-oxide ceramic which has diverse industrial application.

2. LITERATURE REVIEW

Sara Soleimanzadeh (2015):

This research is a necessary first step in evaluating the potential of Bamboo ash as an additive in mortar and facilitating its future use in constructive applications.

Ahmad (2000):

In Asia, bamboo is quite common as one suitable material that is sufficiently cheap and plentiful to meet the extensive need for economical use.

1. **Dinakaran G (2016):**

Substitution of Bamboo ash as a cement substitute is an upcoming research topic. It compromises in strength and durability characteristics and that this replacement was found to be optimum one.

2. **Sijo M T (2015):**

Among the various methods, stir casting route is simple, less expensive and used for mass production. Since metal matrix composites lack structural simplicity its analytical modelling is complex.

Houyem Abderrazak:

Silicon Carbide has exclusive properties such as high hardness and strength, chemical, and thermal stability, high melting point, oxidation, resistance, high erosion resistance, high erosion resistance etc.,

3. **Magnus Willander:**

The most suitable and established SiC polytype for High Temperature power electronics is the hexagonal 4H polytype. The main advantages are wide bandgap, high electric field strength and high thermal conductivity.

3. PROBLEM DEFINED

The main problem discussed in this report is that the kind of material used for car dashboard in terms of texture, appearance and mass of the dashboard. Secondly, the dashboard should absorb the vibration when the car is at high speed. Lastly, one of the problems faced in Ford vehicles are that the location of the USB port in the wrong place. The main aspects focused here are the problems faced by drivers because of material and wrong location of USB port, as well as the customers need better dashboard with new technology, material, design and innovation are timely being updated. The aim of this report is to study the development of car dashboard by providing improvement in

existing product or add new functions to meet the customer needs and expectations.

The problem definition of this report is the development of car dashboard by providing new composite materials with fraction of reinforcement or modifying the present condition and analyse with their various ratio aspects as well. Firstly, find the new reinforced materials that need to develop in the car dashboard. Secondly, find the new stability with durability and other required status of the needed to be incorporated in the car dashboard.

4. TECHNICAL METHODS

4.1. SELECTION OF MATERIALS

Bamboo Ash and Silicon Carbide alloy chemical composition was selected as matrix for the investigation. Chemically pure silicon carbide (SiC) particles having average particle size and processed ash derived from controlled burning and sieving of dry bamboo leaves were used as reinforcement for the matrix.

4.2. BAMBOO ASH

Bamboo ash comes from pieces of bamboo plants, harvested after at least five years, and burned in ovens at temperatures ranging from 800 to 1200 °C. It benefits environmental protection by reducing pollutant residue. It is an environmentally friendly material featuring excellent absorption properties.

4.3. Silicon carbide

The characteristics of the elastic modulus and thermal expansion are given by the characteristics of the SiC crystal itself, and the thermal conductivity or thermal diffusivity of the silicon carbides tends to be substantially higher than those of the other structural ceramics. The combination of a high elastic modulus and moderate coefficient of thermal expansion makes the SiC susceptible to thermal shock damage. The resistance to thermal shock is significantly lower than that of silicon nitride, but higher than the structural zirconia ceramic. The behaviour before thermal shock is also very dependent on the application. For example, very rapid temperature changes can lead to a preference for Si₃N₄ over SiC, while for moderate rates of temperature change the high thermal conductivity of SiC can lead to better performance.

4.4. Epoxy Resin

Epoxy refers to any of the basic components or cured end products of epoxy resins, as well as a colloquial name for the epoxide functional group. Epoxy resins, also known as polyoxides, are a class of

reactive prepolymers and polymers which contain epoxide groups.

Epoxy resins may be reacted (cross-linked) either with themselves through catalytic photopolymerization, or with a wide range of co-reactants including polyfunctional amines, acids (and acid anhydrides), phenols, alcohols and thiols (usually called mercaptans). These co-reactants are often referred to as hardeners or curatives, and the cross-linking reaction is commonly referred to as curing.

5. Preparation Process

5.1. Preparation of Bamboo ash

Dry bamboo leaves were gathered from the environment of farm lands having a large mass of bamboo trees. The bamboo leaves were placed in a metallic drum and fired in open air to allow for thorough combustion. The ash produced from the burning process was allowed to cool for 24 hours before removal from the drum. The ash was then conditioned using a furnace at a temperature of 650° C for 3 hours. Sieving of the bamboo leaf ash was then performed using a sieve shaker to obtain ashes with mesh size under 50 µm.



Fig -1: Burning Bamboo

5.2. Ball Milling

After the preparation of Bamboo Ash, it is crushed using Ball Milling to reduce the particle size of Bamboo Ash from 50µm to 6195.1nm because of higher size of particles. It will affect the final surface finishing of fibre material.



Fig -2: Ball Milling

5.3. Die Preparation

The Bamboo Ash, Silicon Carbide, Epoxy Resin Ly 556 and Epoxy Hardener Hy 951 are used to mix at a following ratio into a shaped die to prepare die samples. The die is prepared at the dimension of 200 X 250 mm at a thickness of 3mm. The ice sticks are pasted above the cardboard for the similar dimension to prepare die. After die preparation the samples are tested to test their composition strength.



Fig -3: Die

6. Types of testing

Compression stress, Compression load and Water absorption tests are taken to identify the strength of material.

Four Different types of samples are prepared to analyse the mechanical strength of the composite material

Table -1: Material Ratio

Products	Sample 1	Sample 2	Sample 3	Sample 4
Bamboo Ash	6%	7%	5%	10%
Silicon Carbide (SiC)	4%	3%	5%	0%
Epoxy Resin	90%	90%	90%	90%

6.1. XRD

It is laboratory-based technique commonly used for identification of crystalline materials and analysis of unit cell dimensions.

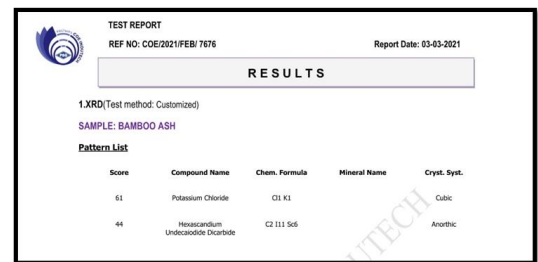


Chart -1: XRD

6.2. FTIR

Fourier Transform Infrared (FTIR) Spectroscopy, is an analytical technique used to identify the presence of certain functional groups in an organic molecule.

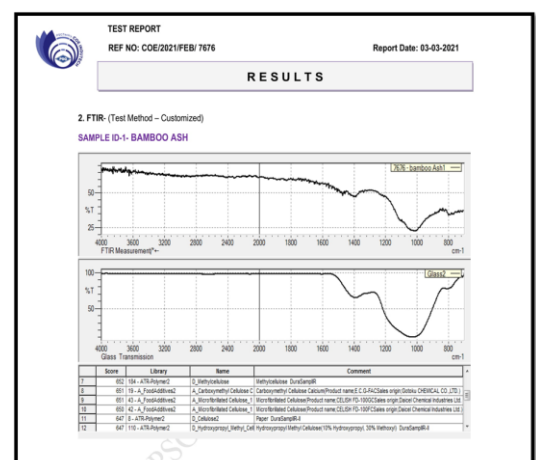


Chart -2: FTIR

6.3. Particle Size

Measurement Results

Date : Thursday, March 04, 2021 4:00:41 PM
 Measurement Type : Particle Size
 Sample Name : Consultancy
 Scattering Angle : 173
 Temperature of the holder : 25.0 °C
 T% before meas. : 9633
 Viscosity of the dispersion medium : 0.896 mPa-s
 Form Of Distribution : Standard
 Representation of result : Scattering Light Intensity
 Count rate : 3099 kCPS

Calculation Results

Peak No.	S.P.Area Ratio	Mean	S. D.	Mode
1	0.28	2.9 nm	0.2 nm	2.9 nm
2	0.42	1123.5 nm	158.3 nm	1120.8 nm
3	0.31	6526.9 nm	628.7 nm	6810.9 nm
Total	1.00	2473.2 nm	2760.8 nm	2.9 nm

Cumulant Operations

Z-Average : 6195.1 nm
 PI : 1.369

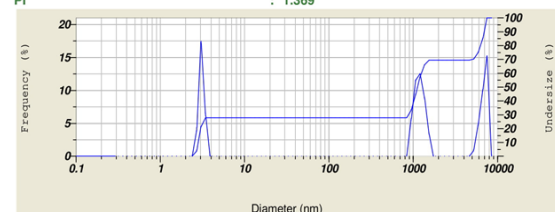


Chart -3: Particle Size

6.4. Compression test

Pressure testing is perhaps the most basic sorts of mechanical testing, close by malleable and flexion tests. Pressure tests are utilized to decide a material's conduct under applied squashing loads, and are ordinarily led by applying compressive strain to a test example (generally of either a cuboid or round and hollow calculation) utilizing platens or particular installations on a widespread testing machine. During the test, different properties of the material are determined and plotted as a pressure strain chart which is utilized to decide characteristics like versatile cut-off, relative breaking point, yield point, yield strength, and, for certain materials, compressive strength.

For the compression test the standard dimension is required to analyse the results. ASTM D 3410 standard is used to analyse the result (150 x 25 x 3) mm.



Fig -3: Compression Test

The compressive stress formula is:

$$CS = F \div A \quad (1.0)$$

where CS is the compressive strength, F is the force or load at point of failure and A is the initial cross-sectional surface area.

6.4.1. Compression Stress

The Graph represents the ratio of load in Newton (Y-axis) and length in millimetre (X-axis).

6.4.1.1. Sample 1

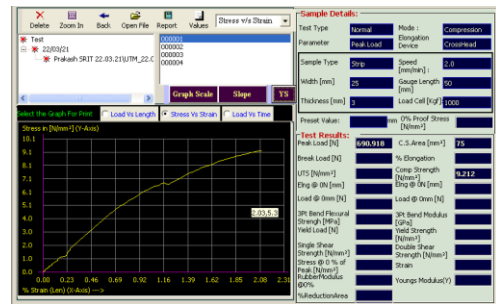


Chart -4: Compression stress sample 1

6.4.1.2. Sample 2

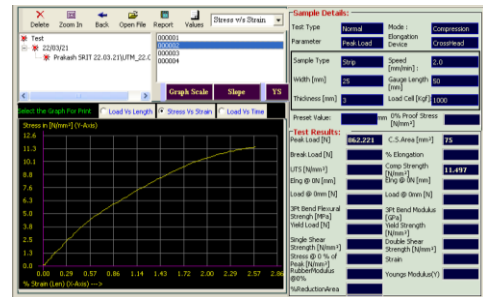


Chart -5: Compression stress sample 2

6.4.1.3. Sample 3

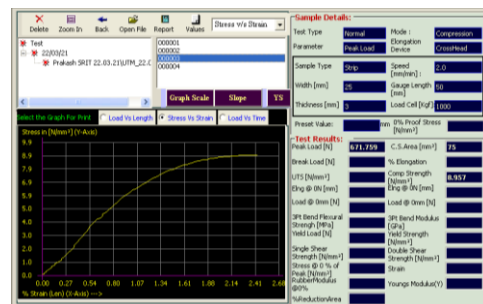


Chart -6: Compression stress sample 3

6.4.1.4. Sample 4

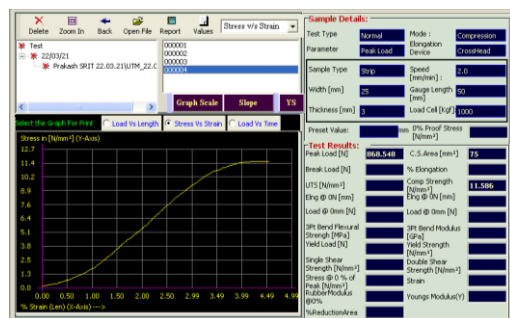


Chart -7: Compression stress sample 4

6.4.2. Compression Load

The Graph represents the ratio of Stress in N/mm² (Y- axis) and Percentage of Strain (length) (X- axis).

6.4.2.1. Sample 1

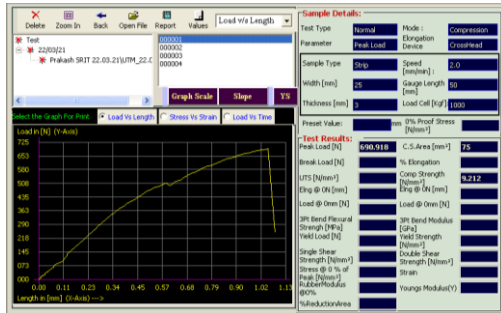


Chart -8: Compression load sample 1

6.4.2.2. Sample 2

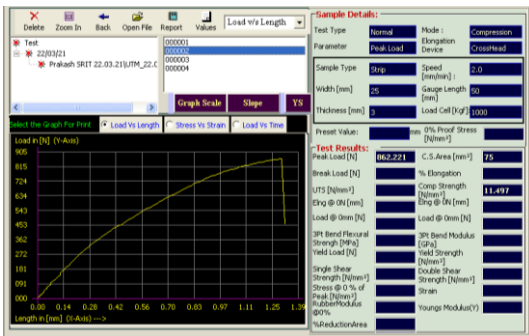


Chart -9: Compression load sample 2

6.4.2.3. Sample 3

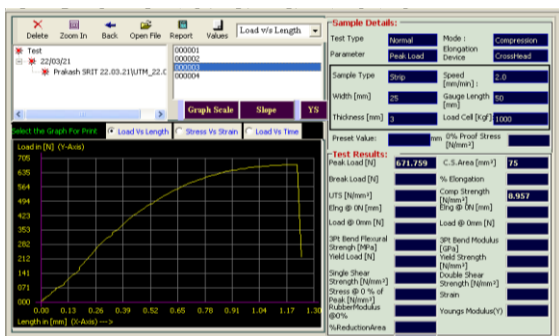


Chart -10: Compression load sample 3

6.4.2.4. Sample 4

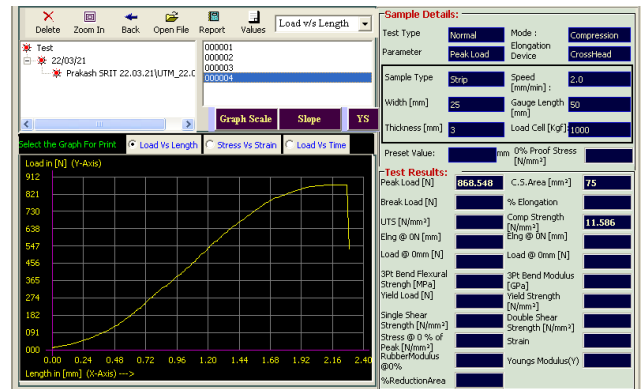


Chart -11: Compression load sample 4

6.5. Water absorption

It is determined as the dampness content, which is equivalent to: (weight of the compartment with wet soil less the heaviness of the holder with dry soil) partitioned by (weight of the compartment with dry soil less the heaviness of the holder), at that point duplicated by 100 to communicate it as a rate

$$\% \text{ of Water Absorption} = \frac{(\text{Difference in Weight} / \text{Original Weight}) \times 100}{(1.1)}$$

For the water absorption test the standard dimension is required to analyze the results. ASTM D 5229 standard is used to analyze the result (20 x 20 x 3) mm.

Table -1: Water Absorption Results

Sample Number	Weight before test in grams	Weight after test in grams (24 hours)	% of water absorption
1	1.7	1.7	0.0
2	1.61	1.61	0.0
3	1.32	1.32	0.0
4	1.57	1.57	0.0

7. MASS

Regarding mass the dashboard ought to be light weight and solid, this may likewise improve the eco-friendliness.

8. SCOPE

The extent of this report is to furnish a client with great scramble board in which the client can get settled

utilization of electronic ports (USB) with reasonable position and make the drive helpful. The clients need to give premium look of run board by utilizing quality material of SiC and Bamboo Ash and make it more alluring to clients. The scramble board ought to be furnished with inflexible and solid material and control the vibration in the lodge and make the drive more OK with commotion free to the client.

9. TECHNICAL OUTCOMES

To counsel an answer, we need to think about the advancement, procedures and material and increment the solace and comfort in vehicle run board, with diminishing the measure of vibration and commotion in the lodge, On the other hand, improvement of vehicle run board to meet the client needs and assumptions by improving the current scramble board or grow new one. To make a stage to have an applied arrangement, fitting examination is needed by breaking down information and data with respect to run board solace and accommodation.

Another important feature is that, to give the dash board a premium look by selecting proper material and improve the texture, noise and strength.

10. RESULTS AND DISCUSSION

The hardness, ultimate tensile strength, and percent elongation of the hybrid composites decreased with increase in Bamboo Leaf Ash content. The density of the composite decreased with increase in bamboo leaf ash particles and porosity increased slightly. The hardness and tensile strength of composites enhanced by incorporating bamboo leaf ash particles and percentage of elongation were decreased. Highest hardness and tensile strength observed at 4 wt.% of Bamboo leaf ash containing in the composite. It was concluded that uniformly spread and larger size voids are presented in the fracture morphology of matrix alloy and size of the dimples and voids decreased with increase in Bamboo leaf ash content in the composites.

11. CONCLUSIONS

The specific Gravity of Bamboo Ash gotten was less compared to that of Other Particle Composites it replaced, which means greater volume of Bamboo Ash will result from mass replacement.

The use of Bamboo ash and Silicon Carbide will reduce the cost, environmental problems and land fill area for the dispose of bamboo trees.

The predicted properties of bamboo ash with Silicon carbide composite of Sample 1 gives the assurance that it will be the replacement of other materials used in the automobile applications. Usage of bamboo ash in the composite will leads to an eco-friendly material.

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