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MECHANICAL PROPERTIES OF BRICK POWDER AND DATES POWDER FILLED EGF REINFORCED EPOXY COMPOSITES

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ABSTRACT: This researchwork describes the mechanical properties of E- glass fiber reinforced epoxy compositesfilled with varying concentration of dates seed powder and brick powder. Composites were fabricated by simple hand layup technique. The prime objectives of this work were to evaluate the mechanical properties such as ultimatetensile strength, impact strength, flexural strength and hardness.The experimental result shows that the composite filled by (5% Vol.) of brick powder exhibits the maximum tensile strength.Fabricated composites exhibited maximum impact strength & Flexural strength when filled with (10% Vol.) of brick powder and dates seed powder.The maximum hardness strength observed when composite filled with 5%Vol of dates seed powder.

KEYWORDS: Composites,E-glass fiber, Epoxy, Brick powder, Dates powder.

I. INTRODUCTION

In general, the properties of composite materials are superior in many respects, to those of the individual constituents. This has provided the main motivation for the research and development of composite materials[1]. Properties of composites are strongly dependent on the properties of their constituent materials, their distribution and the interaction among them. Among the composite materials fiber-reinforced polymer composites are the most widely used one. The addition of fibers to the polymer matrix increases the mechanical strength of the composite material as compared to the neat polymer. Epoxy is one of the thermosetting polymer resins with excellent properties. Epoxy processes outstanding cost to performance ratio. Some of the properties possesses by epoxy are good adhesion to substrate materials, low viscosity, high strength low creep and low shrinkage during curing. Due to these excellent properties epoxy resin widely used for many applications such as in ship building, aerospace, automobile and structural applications [2].Nowadays fiber Reinforced composites are widely used for many applications like structural, marine, aerospace, automobile, windmill blades etc., because of their high strength to stiffness, weight to stiffness ratio. Many researchers have attempted with different fibers and resins ratios, to obtain the high toughened material.

II. EXPERIMENTATION

2.1 Materials

The raw materials used in this work are E-glass fiber andcommercially available ARALDITE (L-12) along with hardener K-6.Dates seed powder and Brick powder wereused as a filler material. Dates seed powderhas value of density 1.33g/cm^3 and is prepared in grinding machine. Dates seed filler are potential candidates for the development of new composites because of their high strength and high hardness property. Brick powder usually has density of 1.43g/cm^3 and has high hardness, good compressive strength and flexure strength. It also provides an adequate insulation against heat and cold.

2.2 Fabrications of Composites:

The E-glass /Epoxy based composites filled with varying concentrations (5 and 10 Vol %) of dates seed powder and brick powder were prepared. The volume fraction of fiber, epoxy and filler materials were determined by considering the density, specific gravity and mass. Fabrication of the composites is done at room temperature by hand lay-up techniques. The required ingredients of resin, hardener, and fillers are mixed thoroughly in a basin and the mixture is subsequently stirred constantly. The glass fiber positioned manually in the open mold. Mixture so made is

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brushed uniformly, over the glass plies. Entrapped air is removed manually with squeezes or rollers to complete the laminates structure and the composite is cured at room temperature.

2.3 Specimen preparations:

The prepared slabs of the composite materials were taken from the mold and then specimens were prepared from composite slabs for different mechanical tests according to ASTM standards. The test specimens were cut by prepared composite laminate by using different tools in work shop. Three identical test specimens were prepared for different tests.

2.4 **Specimen geometry and dimensions**

The geometry for E-glass fiber reinforced epoxy composites filled with varying concentration of dates seed and brick powders in figures 1-3 below and is based on American Society of Testing & Materials (ASTM)

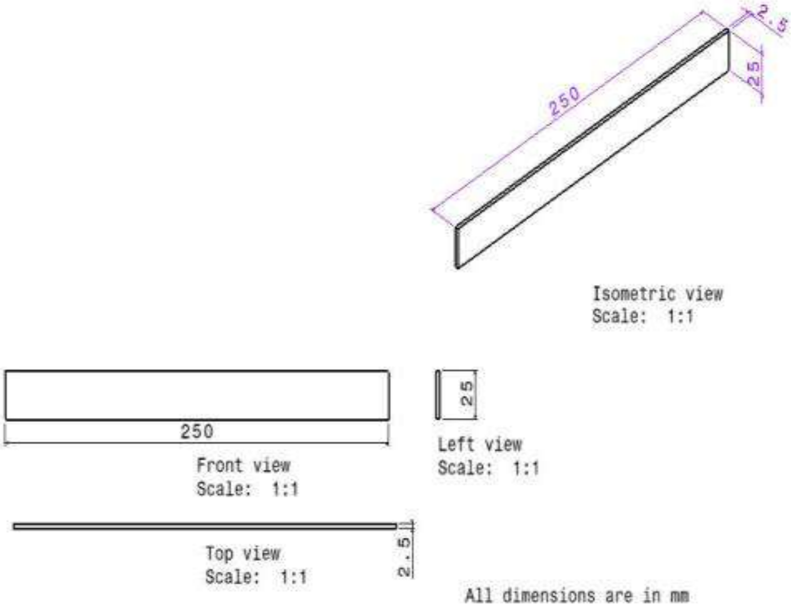

Fig.1 Tensile test specimen

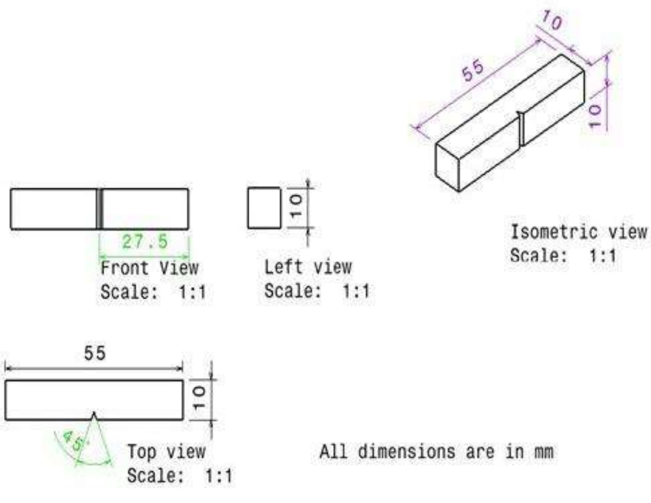

Fig.2 Charpy impact test specimen

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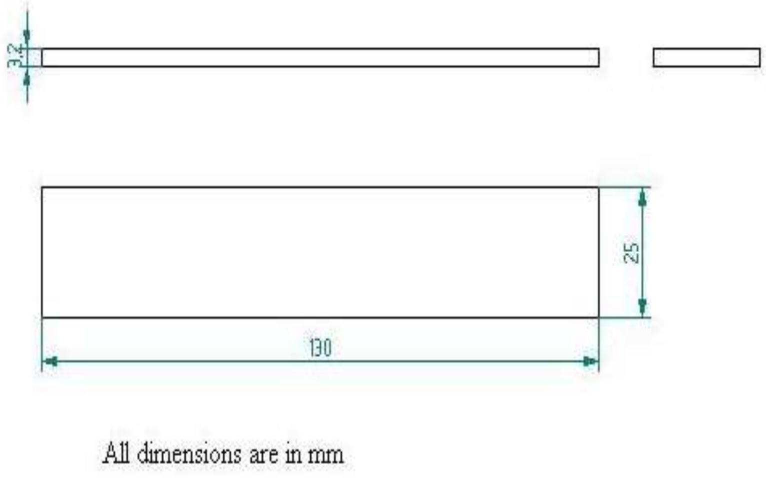

Fig.3 Flexural strength test specimen

III. MECHANICAL PROPERTY TESTING

Tensile strength , flexural strength, impact and hardness tests were carried out by using Universal testing machine, impact machine and hardness testing machine respectively. Three identical samples were tested for tensile strength, bending, impact strength and hardness.

3.1 Tensile Strength:

The tensile character of prepared samples was determined at room temperature using Universal testing machine in accordance with ASTM D3039. Test specimens having dimension of length 250 mm, width of 25 mm and thickness of 2.5 mm. The specimen was loaded between two manually adjustable grips of a 60 KN computerized universal testing machine (UTM) with an electronic extensometer. Each test was repeated thrice and the average value was taken to calculate the tensile strength of the composites.

1. **Details of Universal Testing Machine**

Universal testing machine is a Micro Control Systems make and model MCS-UTE60 and software used is MCSUTE STDW2KXP. System uses add-on cards for data acquisition with high precision and fast analog to digital converter for pressure/Load cell processing and rotary encoder with 0.1 or 0.01 mm for measuring cross head displacement (RAM stroke). These cards are fitted on to slots provided on PC's motherboard WINDOW9X based software is designed to fulfill nearly all the testing requirements. MCS make electronic extensometer is used with an extremely accurate strain sensor for measuring the strain of the tensile samples.

3.2 Impact Strength:

The Charpy impact strength of composites was tested using a standard impact machine as per ASTM E23 standard. The standard test specimen 55mm long 10 x 10mm^{2}cross section on one side surface of specimen a V-notch have been made at an angle of 45^{o}with root depth of 2mm. Test was repeated thrice and the average values were taken for calculating the impact strength.

3.3Flexural Strength:

Flexural strength is determined by 3-point bend test. The test specimen of dimension 130 mm × 25mm×3.2 mm were used for test. This test method determines the flexural properties of Eglass fiber reinforced polymer composites. Flexural strength is calculated by the following equation from the standard ASTM D 790

$$\sigma_f = \frac{3PL}{2bh^2} \text{------------------- (1)}$$

Where
σ_f = Stress in the outer fibers at midpoint (MPa)
P = Load at a given point on the load-deflection curve (N)
L = Support span (mm)

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b = Width of beam tested (mm)
h = Depth of beam tested (mm)

3.4 Brinell Hardness Test:

Brinell hardness test was conducted on the specimen using a standard Brinell hardness tester. A load of 250 kg was applied on the specimen for 30 seconds using 5mm diameter hard metal ball indenter and the indentation diameter was measured using a microscope. The hardness was measured at three different locations of the specimen and the average value was calculated. The indentation was measured and hardness was calculated using equation (2).

$$BHN = \frac{2P}{\pi D\,[D - \sqrt{(D2 - d2)}]} \text{------------------} \quad (2)$$

Where:
P= Applied force (kgf)
D= Diameter of indenter (mm)
d= Diameter of indentation (mm)

Table 1: Designation of Composites

Material Designation	Glass Fiber (% Volume)	Epoxy (% Volume)	Filler Materials (% Volume)
GE	50	50	Nil
GED1	50	45	5 % dates seed powder
GED2	50	40	10 % of dates seed powder
GEB1	50	45	5 % of brick powder
GEB_2	50	40	10 % of brick powder

IV. RESULTS AND DISCUSSION

The ultimate tensile strength, impact strength, flexural strength and Brinell hardness number for different composition of composite materials are presented in tables 2- 5 and their variations as shown in figures 5 to 8 respectively.

4.1 Ultimate Tensile Strength

The tensile strength of the composite materials depends upon the strength and modulus of the fibers, the strength and chemical stability of the matrix, the fiber matrix interaction and the fiber length.

Table 2: Comparison of Ultimate Tensile Strength

GFRP Composites	Ultimate tensile strength in (MPa)
GE	364.8
GED1	292
GED2	338.4
GEB1	363.2
GEB2	284.8

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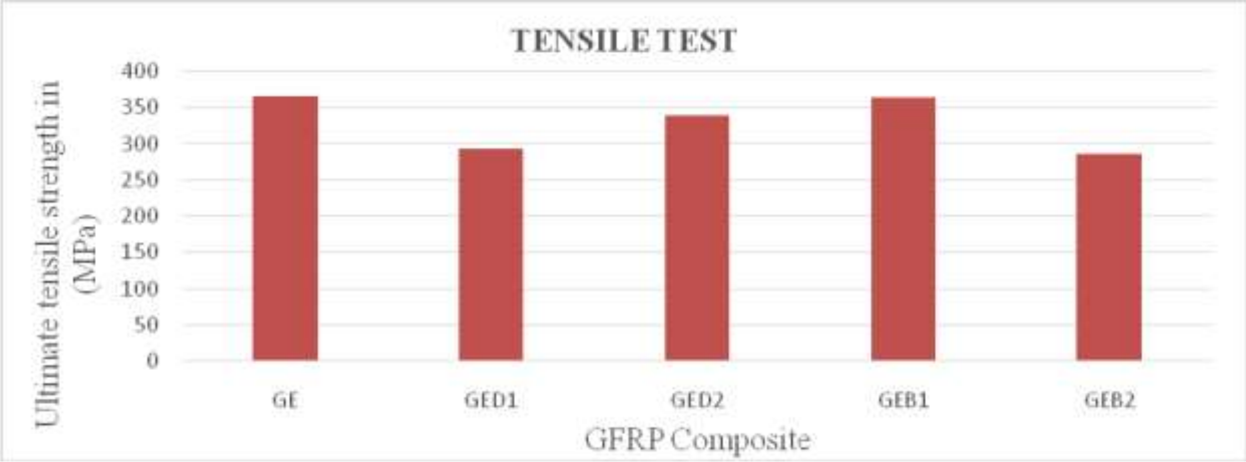

Figure 3.1 Effect of fillers on Tensile Strength

The variation of tensile strength of composite materials is shown in Figure 3.1. It is observed that the tensile strength of 5 % vol. brick powder filled composite (GEB1) exhibited higher ultimate strength when compared with the other filled composites but lower than the unfilled composite. This may be due to the uniform distribution of filler material and strong polymer/filler interface adhesion. But tensile strength decreases with increase in addition of brick powder filler content this decrease in strength may be due to more filler material in the composites damages the matrix. Less volume of fiber and more void formation. Ultimate tensile strength increase with addition of dates seed powder this may be improved in interfacial bonding between filler, matrix and fiber.

4.2 Impact Strength:

The impact properties of composite materials are directly related to overall toughness and composite fracture toughness is affected by inter laminar and interfacial strength parameters.

Table3: Comparison of Charpy Impact Strength

GFRP Composites	Charpy impact test in J/mm2
GE	0.1666
GED1	0.2000
GED2	0.2160
GEB1	0.2800
GEB2	0.3750

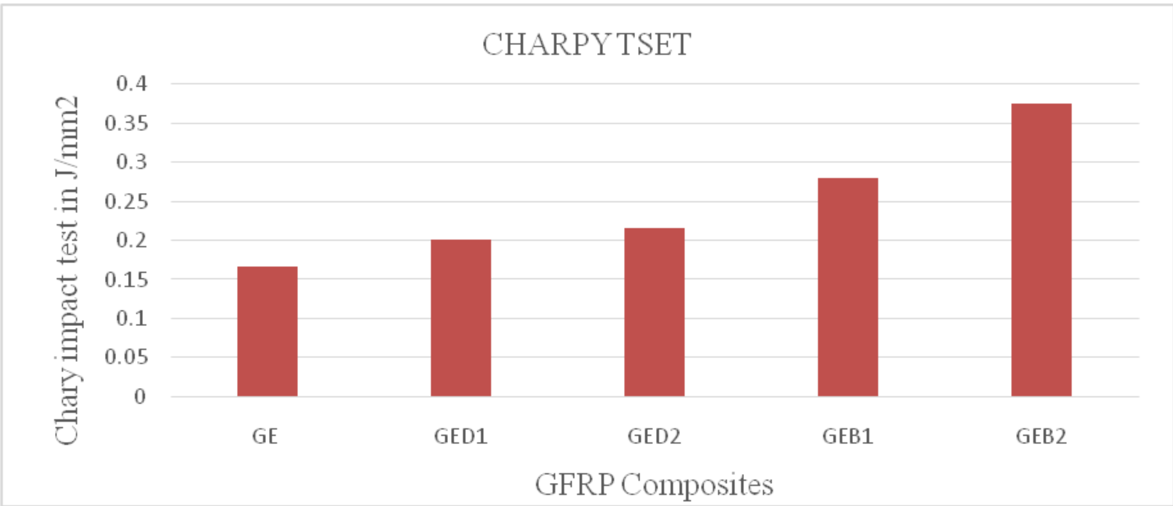

Figure3.2 Effect of fillers on Charpy Impact Strength

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From figure 3.2it is observed that impact strength increases with increase in addition of filler content in the composites. This may be due to the good compatibility of filler and epoxy resin. The maximum impact strength was observed when composite filled by 10% vol. of brick powder (GEB2) when compared with other filled composites.This is due to that good bonding strength between filler, matrix, fiber and flexibility of the interface molecular chain resulting in absorbs and disperses the more energy,

4.3 Flexural Strength:

Table4: Comparison of Flexural Strength

GFRP Composites	Flexural strength in (Mpa)
GE	880
GED1	1028
GED2	1120
GEB1	920
GEB2	1040

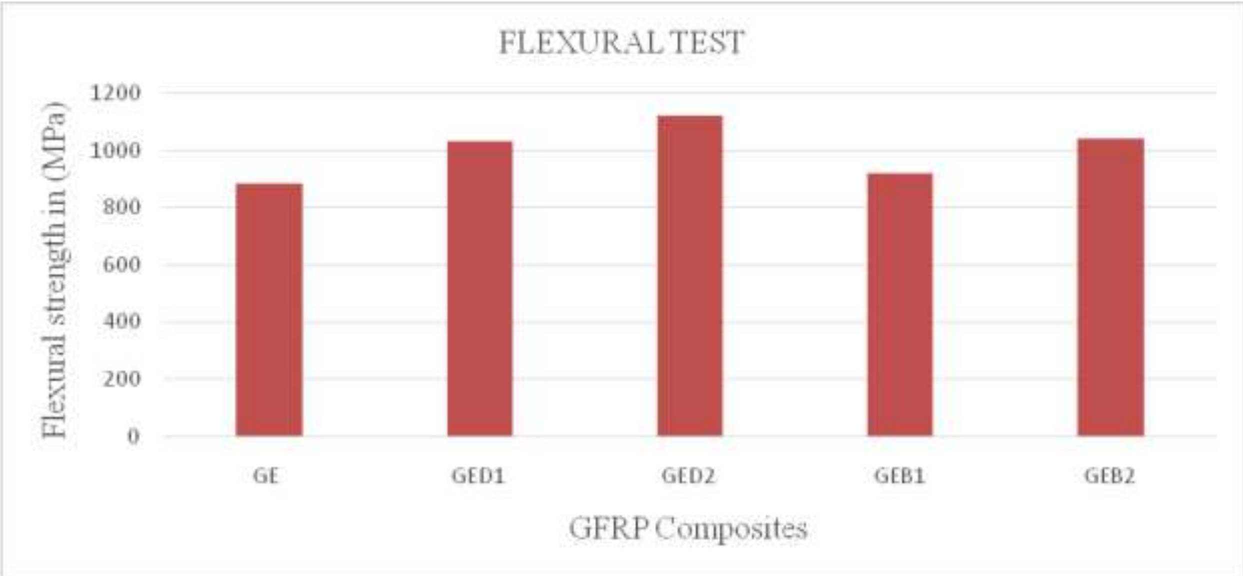

Figure 3.3 Effect of fillers on Charpy Impact Strength

The variation of flexural strength of composite materials is shown in Figure 3.3It is interesting to note that flexural strength increases with increase in addition of filler content. This may be due to the good compatibility of filler and epoxy resin. Remarkable improvement in flexural strength was observed in GED2 and GEB2 composite materials as compared to otherfabricated composite materials.

4.4 Hardness Test

Table4: Comparison of Brinell hardness Test

GFRP Composites	BHN
GE	88.72
GED1	179.38
GED2	64.82
GEB1	72.037
GEB2	88.72

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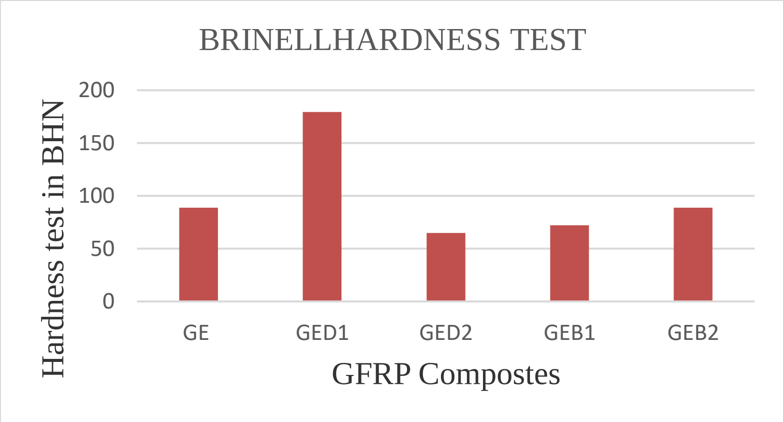

Figure 3.4 Effect of fillers on Hardness

The experimental results show that composite filled by 5% vol. dates powder exhibits the maximum hardness number when compared with the other filled composites this due to uniform dispersion of filler particles and good bonding strength between fiber and matrix.It is noted that hardness of the composites increases with increase in addition of brick powder filler content because decrease in inter particle distance and with increasing particle loading in the matrix results in increase of resistance to indentation.

II. CONCLUSION

The experimental study reveals that the effect of filler materials on mechanical properties of fabricated E-glass fiber reinforced polymer composites leads to the following conclusions.

1. The E-glass fiber reinforced epoxy composites filled with of dates seed powder and brick powder filler has been successful fabricated by simple hand lay-up technique. It has been observed that the mechanical properties of the composites such as tensile strength, impact strength, flexural strength and hardness of the composites are greatly affected by the filler content

2. The experimental results show that the 5%vol brick powder filled composite (GEB1) exhibits maximum ultimate tensile strength when compared with the other filled composites. But lower than unfilled composites.

3. From the experimental results it was observed that flexural strength increases with increase in the addition of filler content. Composite with 10%vol. of date's powder filled (GED2) composite shows the better flexural strength.

4. The impact strength of composite material increases with increase in addition of filler materials. Composite with 10%vol. of brick powder filled (GEB2) shows the maximum impact strength.

5. It was observed that from the experimental results the composite filled with 10%vol .dates powder (GED2) exhibited maximum hardness number.

REFERENCES

[1] Wasim Akram, 2 Sachin Kumar Chaturvedi, 3 Syed Mazhar Ali,"Comparative Study Of Mechanical Properties Of E-Glass/Epoxy Composite Materials With Al2O3, CaCo3, SiO2 AND PBO Fillers", International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 7, July – 2013, ISSN: 2278-0181

[2] Susilendra Mutalikdesai1, Akshay Hadapad2, Sachin Patole3, Gururaj Hatti, Fabrication and Mechanical Characterization of Glass fibre reinforced Epoxy Hybrid Composites using Fly ash/ Nano clay/ Zinc oxide as filler,IOP Conf. Series: Materials Science and Engineering **376** (2018) 012061 doi:10.1088/1757-899X/376/1/012061

[3] Sudeep Deshpande, T.Rangaswamy Effect of fillers on E-glass/jute fiber reinforced epoxy composites

[4] B.Shivamurthy, Mechanical properties of Jatropha seed cake waste/Epoxy composites by B.Shivamurthy, Krishnamurthy.Peter Joseph.

[5] J.M.L. Reis, J.L.V. Coelho, A.H. Monteiro, H.S. da Costa Mattos, 'Tensile behavior of glass/epoxy laminates at varying strain rates and temperatures", Composites: Part B, Vol. 43, 2012, pp. 2041–2046[6] A.P. Mouritz and Z. Mathys, "Post-fire mechanical properties of glass-reinforced polyester composites", Composites science and technology, Vol. 61, 2001, pp. 475-490

[6] Cedric Sauder, Jacques Lamon and Rene Pailler, "Thermo mechanical properties of carbon fibers at high temperatures (up to 20000c)", Composites science and technology, Vol. 62, 2002, pp. 499-504

[7] Mahavir Choudhary, Tej Singh- Waste marble dust-filled glass fiber-reinforced polymer composite Part I: Physical, thermo mechanical, and erosive wear properties.