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Research Article

Thermal Conductivity and Mechanical Characterization of Bamboo Fiber and Rice Husk/MWCNT Filler Epoxy Hybrid Composite

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Recent trends utilizing recycled materials from around the world aim to improve a wide range of industrial and domestic applications. The natural fiber/filler matrix is used to evaluate the mechanical qualities of the hybrid nanocomposites. The specific concentration is dealing with a bidirectional bamboo fiber mat/rice husk particle/MWCNT blend with epoxy composite. The experimental work plan to execute with the three different proportional composites was as follows: bamboo fiber mat constant loading for all the specimens, but the filler particle ratio will be varied, prominently rice husk particle concentrated for all the three specimens: 5%, 10%, and 15%, and additionally, MWCNT drawn two specific specimens (2 and 3): 0.5% and 1% based on the fiber/filler concentration balanced the epoxy resin. The research presented here is hybrid nanocomposite experimented with thermal, mechanical, and morphological characterization. Thermal conductivity measured by Lee's disc method is observed at 0.2577 W/mK for specimen 3. The tensile and flexural properties are higher for 0.5% MWCNT concentration (specimen 2): 42.66 MPa and 54.72 MPa, respectively. The maximum impact strength is reached at 1% MWCNT concentration (specimen 3). Bamboo fiber and rice husk filler matrix composite (specimen 1) reached extremities shore-*D* hardness 84. Scanning electron microscopy was performed to examine the morphological characteristics of the tensile fractography specimen and analyzed the dispersion of the fiber/filler matrix adhesion of the surface. The bamboo fiber mat/rice husk/MWCNT (specimen 3) filler had better binding and observed fewer fiber pull-out, fiber fracture, fiber extension, and voids. In the graphic comparison, 0.5% MWCNT achieved more mechanical properties than the other two combinations.

1. Introduction

The introduction of new plant-based polymeric materials with high positive results has exploded. Dietary fiber reinforced polymer provided cost effectiveness in order to overcome the marketplace dream, and particular applications may protect both cost and weight, because of cascades for motors, replacements for welded metallic parts, canister, and ducts. Utilization of composite is usually increased day by day, and ownership increased through the business and composite that are usually lightweight, more tightness, more strength, and so on. Additionally, functions have their own corrosion and chemical substance-resistant in character which raise the support life during the particular cycle discussed by Espinach et al. and Huda and Drzal [1, 2]. Many software were simulating the execution of fabrication model low-specific bodyweight, and large level usage of ceramic materials was airbus, plane, and military automobiles in the worldwide exposed by Nurhaniza et al. [3] and Saravanan et al. [4]. Natural composite framework using many programs and materials used dependent on resin soybean oil and organic fibers like flax and recycled was examined by Sathishkumar et al. [5] and Karimah et al. [6].

Prabhudass et al. [7] investigated to improve the mechanical characterization (tensile strength, flexural strength, and impact strength) and thermal characterization (thermogravimetric analysis and derivative thermogravimetric). They designed six different natural fiber laminate composites, including combinations of bamboo and kenaf fiber matrices to attract mechanical characterization and mainly achieved the highest yield strength caused by the stacked fiber mat. The additional impact resistance reached over 80% for the built-in MWCNT to absorb maximum energy. Chee et al. [8] investigated BC/epoxy composites achieved higher thermal stability, with initial and final decomposition temperatures of 348°C and 463°C, respectively, caused by the remaining 11.5% char. Significant degradation noted between temperatures ranges from 250°C to 500°C. Researchers technically discuss the chemical compositions of cellulose, hemicellulose, and lignin. The structure of the epoxy matrix measures the cellulose content to maintain thermal stability compared to hemicellulose due to the crystalline form and the amorphous region. Lignin has aromatic rings that are difficult to breakdown [9]. Ismail et al. [10] fabricated two materials of superior character to improve the physical-mechanical characterization of the hybrid composite. A heterogeneous matrix in bamboo fiber and kenaf to improve the flexural characteristic and impact resistance was examined by the morphological structure. The bamboo fiber combination achieved a maximum flexural strength of 116.4 MPa compared to kenaf fiber. Furthermore, the differences were explored by the addition of coir, allowing the same bamboo and coir fibers to achieve better mechanical properties than kenaf fibers [10]. Supian et al. [11] focused on hybrid characteristics that can improve mechanical properties. The incorporation of the date palm fiber/bamboo composite significantly increases the flexural properties and the impact strength of 61 MPa and 12.7 J/m. Morphological fracture surfaces have been shown to hybridize well with date palm fiber and attractive interfacial adhesion between materials and fewer voids [11]. Date palm fiber was extracted from the trunk tree to examine mechanical, thermal, viscoelastic, and morphological characterization. Maximum thermal stability was achieved by stretching a PDF trunk tree fiber at 22% resource residing on the composite, with weight loss controlled by the TGA method. The morphological structure shows the adhesion of the fibers between the filler matrix [12]. Huang and Young [13] studied the size of the bamboo fiber, the resulting tensile strength, and the modulus of elasticity of the composites increased as the diameter of the bamboo fiber decreased. Balasubramanian et al. [14] manufactured two different concentrations of superiority: jute/bamboo and jute/kenaf composite epoxy. Jute/bamboo achieved extreme tensile and flexural strength, 39.4% higher than the jute/Kenaf fiber epoxy combination [14]. Unidirectional coconut fiber/bamboo thermoplastic matrix composite was examined. They evaluated the morphology of the fracture, a low fraction of bamboo/coir fiber achieved stress and strain failure, and the SEM revealed that the surface was much stiffer and stronger. The tensile strength of the bamboo fibers in the hybrid composite was higher than that of the coir, but the extra coir distracted the elasticity compared to other variants (monocomposite) [15].

Martijanti and Juwono [16] extracted new phase from fibrous materials of steam explosion processes produced bamboo fibers to improve mechanical properties. The researcher focused on innovative materials invented, and natural fibers have different chemical compositions (more than 50% holocellulose in this configuration) to deduce their mechanical properties [16]. The untreated material, which was favorable for the longitudinal bending strength, was higher than the treated material [17]. Long unidirectional bamboo fiber and powder-reinforced composite increased tensile and flexural strength when studying fiber load. They focused on contributing with fibers/powder produced by the compression molding method [18]. Additionally, they tested a fiber loading of 70%. Maintaining the mold temperature at 180°C reduced the flexural strength. After that, the mold temperature was reduced to 160°C, and then it had a flexural strength of 273 MPa, ensuring that the material was biodegradable [19]. Natural Remie/Hemp materials employed as a fiber/filler material reinforced matrix hybrid composite generated more than 75% favoring tensile strength and Young's modulus values [20]. The biocarbon was combined with a prickly pear fiber loaded with a hybrid epoxy composite and improved thermal conductivity with the addition of biocarbon nanosheets, up to a maximum of 0.42 W/mK [21]. Similar research was done on the epoxy resin composite of aloe vera fibers and graphite biochar, and it was found that the thermal conductivity of the RAB3 composite reached 0.54 W/mK [22].

The selection of the fibrous/filler material volume fraction has many consequences for the improvement of the mechanical characterization, and the degradation of the material is a crucial issue. The research gap identified in this article consists of three different variants of the hybrid composite and superior materials selected to withstand mechanical properties, particularly flexural and tensile strength, and the addition of filler material premium quality, the natural rice hull filler/efficient functional MWCNT filler, has played an important role in improving adhesion between micro- and nanoparticles. These materials can ensure the adoption of green environment, recyclable, ecofriendly, and biodegradable.

2. Materials and Methods

Natural fiber resources are gathered at the Modern Mill in Kanchipuram, India. Rice husk particles graded by expert workers with their identification separated the coarse and fine rice hull, and by observation, they removed corroded and bacterial affected hull caused to interrupt mechanical characterization alone [23]. The rice husk is subsequently crushed into flour by the rice husk pulverizer machine. The filtration device may collect particles as fine as 100 microns when utilized by a trained operator. The vacuum lay-up equipment set-up, bamboo fiber mat (bidirectional position), Ly 556 epoxy, and Hy 951 hardener (Figure 1) were supplied by Metro Composite in Chennai, India. Multi-walled carbon nanotubes with diameters of 10 to 20 nm and lengths of 10 microns were acquired from Adnano Technologies in Karnataka, India.

3. Experimental Procedure

The composite was created using a bamboo fiber mat, rice husk/MWCNT filler, epoxy, and hardener (Figure 1). Bamboo fiber mat loading as a uniform layer-like was clothed by woven material [23], whereas additional loading of the rice husk powder particle entrapped by the 100-micron ranges and MWCNT used as a nanomaterial tested by ASTM procedure (Tables 1 and 2). The preparation of the vacuum bagged setup to be sealed in order to maintain below atmospheric pressure limits the plate dimension [24]. They use a wetted cloth to wipe the plate's surface and remove the tiny particles and wax spread evenly over the plate. Allow the agents and breather cloth to settle on top of the plate for a few seconds. Assemble the bamboo fiber mat and check the air space of the mat using the orientation of the fiber. The epoxy should be ready before stacking the mat. As a result, the epoxy preparation procedure is divided into many steps: (1) using a weighing machine, epoxy and hardener are measured in accordance with ASTM standards. (2) The sonication procedure then helped to disseminate the small particles with the coarse particle after the MWCNT filler had been mixed with the epoxy chamber. (3) To make the mixture more homogeneous, rice husk particles are added to the epoxy while it is manually agitated. The produced solution is put to the bamboo fiber mat trapping, rolled to cure it, and allowed a short period of time to allow the filler agent to bond to the fiber. Similarly, further layers were created on top of them, and then epoxy mixed with filler was placed over the mat.

4. Result and Discussion

4.1. Thermal Conductivity. Table 3 shows the thermal conductivity of a bamboo fiber/rice husk/MWCNT epoxy composite with varying fiber loading. The heat conductivity of the composite material was determined using Lee's disc equipment setup. Figure 2 shows Lee's disc setup that comprises of a metallic disc resting on a deep hollow cylinder with the appropriate diameter, a circular disc of a bad conductor specimen, and various accessories for measuring temperature, energy meter, fluid level indicator, and so on. Heat transfers over a temperature gradient from a high temperature and high molecular energy region to a low temperature and low molecular energy region. The rate of heat transfer is determined by the magnitude of the temperature gradient as well as the specific thermal properties of the composite materials. The rate of heat transport through conduction at steady state, as stated by Fourier's law, is given as

$$Q = kA\frac{T_2 - T_1}{L}, \tag{1}$$

$$\mathrm{k} = \frac{M s\,(dT/dt)x}{T_2 - T_1}, \tag{2}$$

where K is the thermal conductivity of the material, A is the area of cross-section, T_2 is the higher temperature, T_1 is the lower temperature, L is the thickness of the specimen, m is the mass of lower disc, s is the specific heat, and dT/dx is the rate of heat per sec.

The specimen must be loaded into the disc chamber in diameter with the required dimensions of 50-60 mm, and the hotness of the stream passing through the chamber will achieve a steady state after 30 minutes. The digital thermometer recorded the temperature readings T_1 and T_2. The gradient level can be determined by comparing the input and output temperatures. Other parameters of the specimen (cross-sectional area A, thickness, mass density, and sample-specific heat) should be effectively utilized to determine the thermal conductivity of the composite material.

Figure 3 shows that the thermal conductivity of specimen 1 bamboo fiber, rice husk particle, and epoxy resin is 0.2061 W/mK. Thermal conductivity was enhanced by incorporating MWCNT into the epoxy resin. The thermal conductivity of MWCNT-filled epoxy composite material is 18% greater. This enhancement is due to the addition of MWCNT in the bamboo fiber composite, which can link between microparticles to integrate heat continuity. Furthermore, the addition of 1% MWCNT particle in specimen 3 marginally increased thermal conductivity due to equivalent proportions of natural fiber bamboo mat and 15% rice husk particle; so, the thermal conductivity of the specimen 3 attempts to withstand the conductivity of 0.2577 W/mK. The difference in thermal performance of the specimens 2 and 3 was 3.3 percent higher than specimen 2. Thermal conductivity differed by 24% between specimens 1 and 3. As a result, the MWCNT drawn in the natural fiber epoxy resin composite interacts reciprocally with the filler particle MWCNT. Bamboo fiber can withstand a few minutes of thermal stability, and it may be conducting heat by MWCNT, but the addition of the filler rice husk particle has more cellulose content; so naturally, hydrophilic in character and water absorption rate is also more, and it concludes that the heat conductivity is very poor but the particle supports to conduct heat path by binding particles. MWCNT has a high adhesion with micromatrix particles; so, the rate of heat movement in MWCNT is faster, but the continued conduction mode by the binding particle rice husk heat flow is slower, and bamboo fiber mat attempts to support heat conduction path but some places may be lagged due to moisture absorption more for both natural fibers; so, the interaction of the fiber also is more.

4.2. Mechanical Properties

4.2.1. Tensile Strength. Figure 4 shows the tensile testing setup with specimens, tensile fractured, and flexural

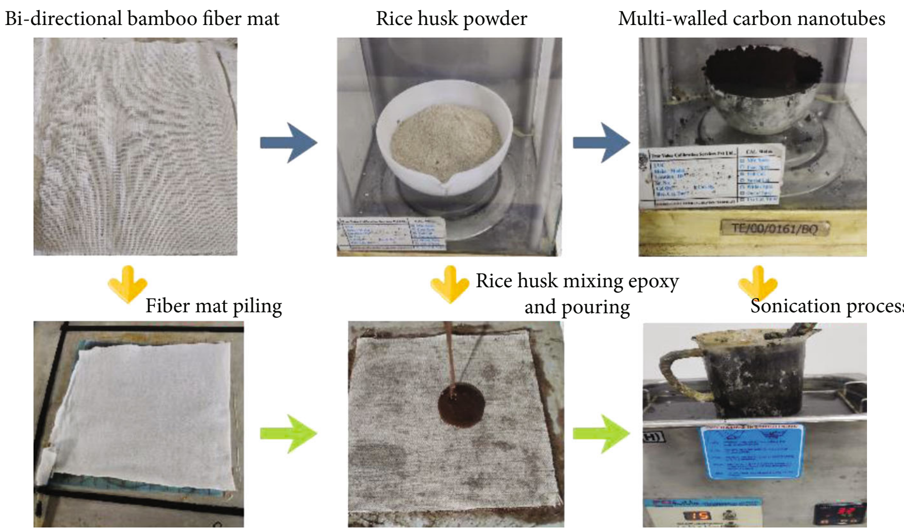

Figure 1: Materials and stages of fabrication.

Table 1: Material compositions.

Materials	Density (g/cm^3)	Specific gravity (g/cm^3)	Elongation (%)	Cellulose (%)	Hemicellulose (%)	Lignin (%)
Bamboo fiber	0.8	0.85	11	46-57	20-25	20-30
Rice husk	1.2	2.11	9.6	35	33	23
MWCNT	2.3	2.6	10.8	—	—	—

Table 2: Designation of the composite in %.

Composite designation	Epoxy (%)	Bamboo fiber (%)	Rice husk (%)	MWCNT (%)
BRE	85	10	5	—
BRME1	79.5	10	10	0.5
BRME2	74	10	15	1.0

B: bamboo fiber; R: rice husk; M: MWCNT; E: epoxy.

fractured surface specimens. The tensile test was performed on a universal test machine with the results shown in Figure 5. In addition, the change in tensile strength obtained depends on the purpose of the composite material to increase the tensile strength of the hybrid composite material while maintaining the optimum load of fibers and filler. The addition of the MWCNT/epoxy hybrid composite filler material has a high tensile strength, because the woven bamboo fibers have an attractive resistance to mechanical damage that acts under the force of the mat tension. Huang and Young [13] observed that the tensile strength of the bonded bamboo fiber was 168.57, and the modulus of elasticity was 8.54 GPa. BRE specimens carrying 5% rice husk content, were noted down that the tensile strength was 38.53 MPa. While testing the sample, load deformation factors were involved, the maximum load applied over the head of the specimen, initial fracture taking more time because of bamboo fiber utilizes maximum yield point alone, fiber reaches the necking point after few seconds, and then materials ready for fracture and crack are propagated in random order due to packing by the epoxy matrix. Then, fractured segment observed the fiber withstanding maximum load, but the synthetic agent initiates the crack in crystal form, and then fiber loses its strength then declined yield strength instantly. Then, crack generates instantly and the breakage of the sample in brittle form and irregular manner. BRME1 specimen carrying 10% rice husk and 0.5% MWCNT is drawn in the composite. The observed tensile strength value for specimen 2 is 42.66 MPa. Similar results for tensile strength were obtained on the 25.5 MPa bamboo/jute epoxy hybrid composite. The maximum tensile strength improved by 10% by the incorporation of rice husk and MWCNT. Rice husk is a richer material, and more cellulose and silica content are present in the fiber. Packing of rice husk particles into the matrix can improve mechanical properties prominently. The inclusion of MWCNT improved interlinks between the microparticles into tiny particles to form a continuous combination of cellular network structures. BRME2 specimen 15% rice husk and 1% MWCNT were drawn in the composite. The observed tensile strength for specimen 3 is 40.03 MPa; again, it declined rapidly with few run iterations observed by the database between machines to computer communication. Similar work was demonstrated that the mold temperature increased after 160°C and further determined that the maximum tensile strength was 169.9 MPa. This combination might be saturated with the fiber/filler ratio, and excess of the natural fiber incorporation is also a consequence of composite material. While loading more filler content into the specimen, stacking of filler deposited in the particular zone might be weaker. While making the specimen, it has to take more time to stir the

Table 3: Thermal and mechanical properties of composites.

Composite designation	Thermal conductivity (W/mK)	Tensile strength (MPa)	Flexural strength (MPa)	Impact strength (J/m)	Hardness (Shore-*D*)
BRE	0.1968	38.53	52.16	39.2	83.5
BRME1	0.2492	42.66	54.72	46.8	82.5
BRME2	0.2577	40.03	49.45	50.4	79

Figure 2: Thermal conductivity measurement by using Lee's disc method.

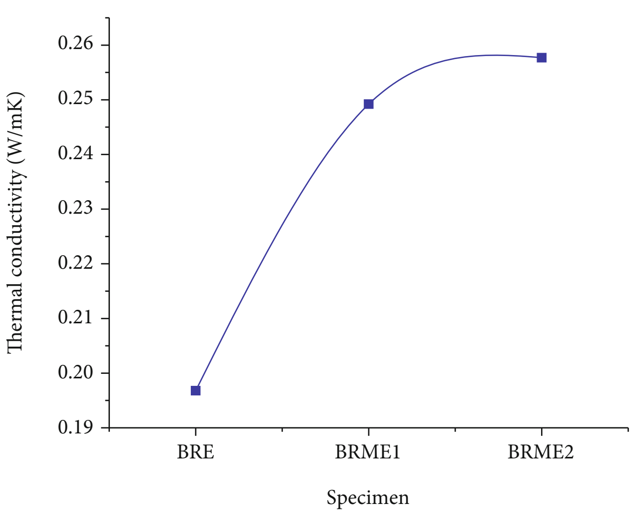

Figure 3: Thermal conductivity vs. bamboo fiber composites.

solution until it gets uniform dispersion throughout the beaker. Then, pouring and curing are also very important parameters to settle the amount of the fiber/filler particle into the plate dimension.

4.2.2. Flexural Strength. The flexural characteristics were performed with a three-point bending device. The bending strength increases with increasing fiber/filler loading, but the bending strength decreases slightly as the loaded fiber exceeds the saturation limit. Specimen 1 carries bamboo fiber mat and 5% rice husk particle, and the 3-point flexural bending machine loaded the sample and knobbed it on 3 points, among two supporting points and one loading point. While applying the load on the specimen, it reacted to bending in the downward direction and reaches maximum deflection. After exceeding the limit, the material gets cracked and then propagates the crack along the specified dimensions. (2019). Similarity results for flexural strength were obtained on the 63.5 MPa bamboo/jute epoxy hybrid composite. In this combination, bamboo fiber mat alone can make maximum yielding point achieved, but initiating the crack by the epoxy instantly breaks the upper layer, lattice structure was deformed, and fiber the stretched maximum yield point. Specimen 2 bamboo fiber mat, rice husk 10%, and addition MWCNT 0.5% were drawn in the composite. Figure 6 observes that the maximum flexural strength is 54.72 MPa. Similar work was demonstrated that the hybrid composite maximum flexural properties were 221.1 MPa. The main factor has been considered to evaluate the addition of rice husk and MWCNT homogenously mixing by sonication process, and the vacuum lay-up method also effectively worked to improve the material bonding between the fiber/filler matrix. So, the maximum strength of 5% has been improved with the existing specimen 1. Similarly, specimen 3 tried additional rice husk, and MWCNT increases to expect higher flexural strength but it slightly degrades the combination. The addition of 15% rice husk particle might be stacked and deposited in a particular zone. So, while applying load on the specimen, the particular place is instantly broken. This caused the failure of the component, which noted down very low flexural strength. Specimen 3 had reached low flexural strength of 49.45 MPa than the other two specimens (1 and 2) even incorporating MWCNT.

4.2.3. Impact Strength. Impact strength was performed with an Izod impact tester. The hybrid nanocomposite made of bamboo fiber/rice husk/MWCNT filler can absorb more energy before being destroyed. The main factor was the increase in impact resistance, and the material obtained a

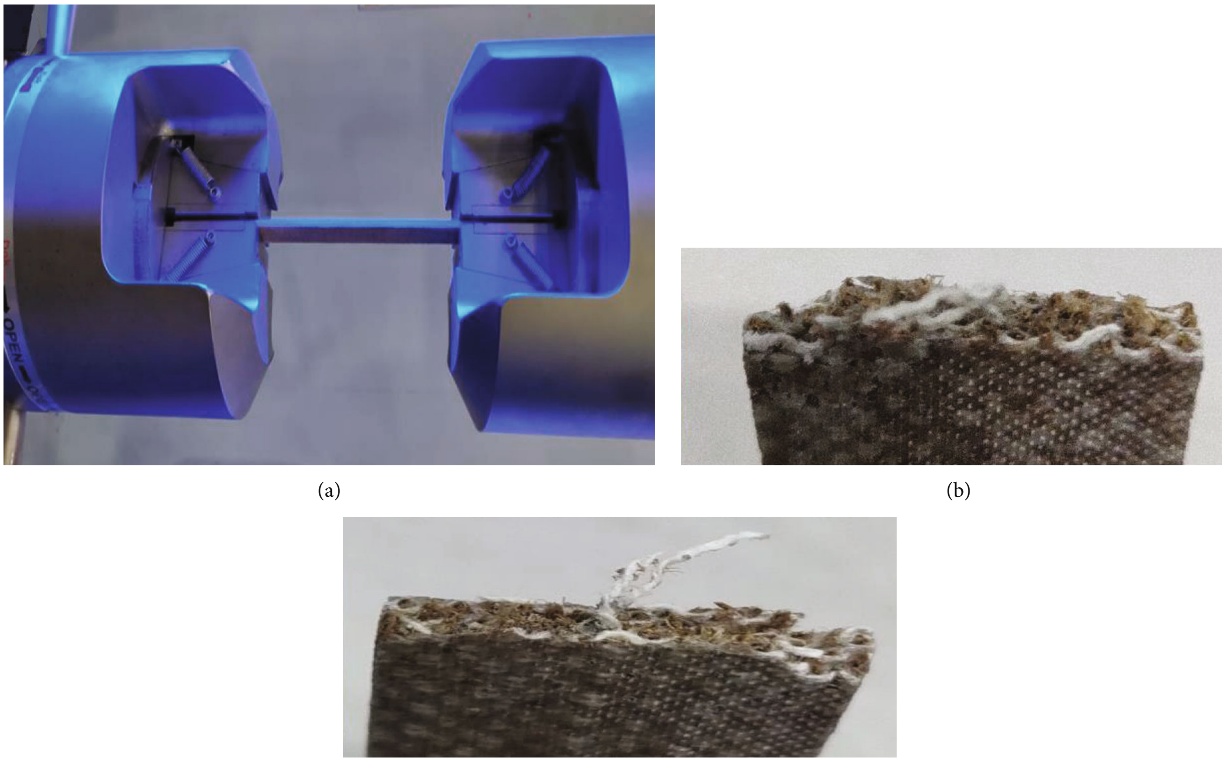

Figure 4: (a) Tensile testing setup with specimen. (b) Tensile fractured. (c) Flexural fractured surface.

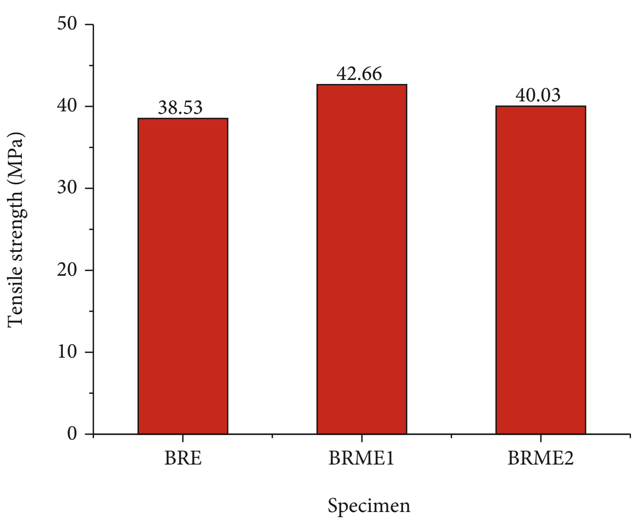

Figure 5: Tensile strength (MPa) vs. bamboo fiber composite.

good interfacial adhesion between fiber/filler particles. The graphical image shows that the maximum impact force for the third specimen reached 48.4 J/m. Figure 7 displays the impact resistance of the relevant fiber/filler content to withstand maximum energy. However, specimen 2 and specimen 3 are closer to the values without significant differences in fiber/filler combinations. The fundamental points of fiber fracture during the loaded condition fiber reacted instantly while absorbing the total impact energy. Once it absorbed the impact energy, the fiber gets fractured, pulled out, and broken. Interestingly, the amount of energy transferred to the specimen is greater than the amount of fiber breaking. The addition of fibers/fillers is an important factor in ensuring an attractive bond between materials and improving mechanical performance, including a significant increase in impact resistance. Specimen 1 had poor impact strength than the other two combinations (specimens 2 and 3) because most of the content was attributed to synthetic materials, and a minority of natural fibers is composed of bamboo and rice husk. After the load was abruptly removed from the specimen, the material was immediately ready to break. This is due to the action of synthetic agents that combine a very low fiber content to remove the specimen from the deviation zone.

4.2.4. Durometer Shore-D Hardness. The hardness test is performed by setting the Rockwell hardness and the Shore-D Durometer Hardness. The function of hardness values is measured by the indenter. The maximum load is applied to the composite to resist indentation or penetration over the surface. The composite ability resists the crack initiation and propagation when subjected to the load. In specimen 1 bamboo fiber, rice husk filler matrix composite resists the maximum deformation and observed 84 Shore-*D* hardness. The main reason to focus is that epoxy is 90% contained in this specimen; so, it is favored for abrasion and indentation; hence, it reached maximum hardness than the other two combinations (specimens 2 and 3). Furthermore, the

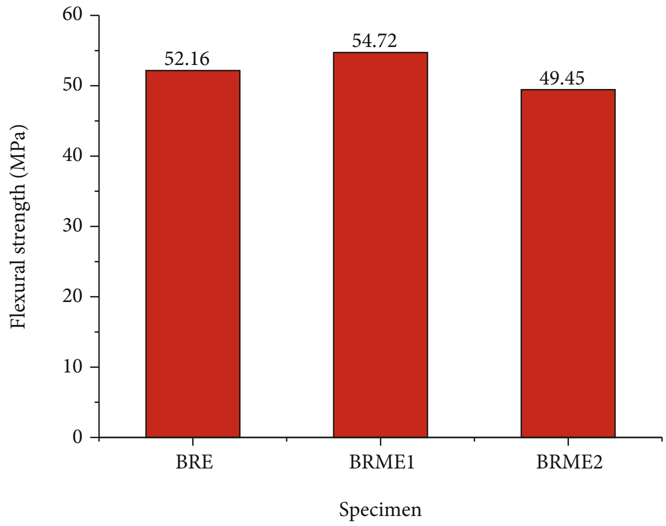

Figure 6: Flexural strength (MPa) vs. bamboo fiber composite.

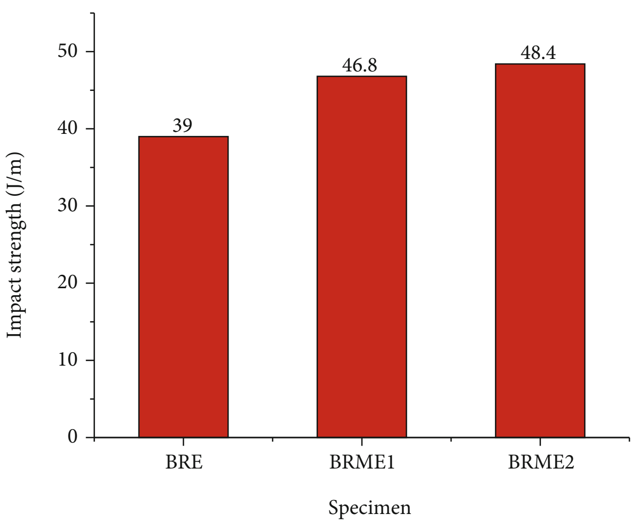

Figure 7: Impact strength (J/m) vs. bamboo fiber composite.

addition of MWCNT in specimen 2 is almost a closer value to specimen 1 82.5 Shore-*D* hardness. Sonication of the rice husk and MWCNT packaging was successful; so, all mechanical parameters were optimal. This is due to the fact that the addition of MWCNT can increase the stiffness and strong interfacial bond between the fiber particles, but specimen 3 observed a lower shore-*D* hardness of 79.5 (Figure 8). The saturation level of the filler particles in the matrix can reduce the mechanical performance. Furthermore, attention must be paid to the actual operation when increasing the materials, thermoplastic and thermosetting agents, and fabrication techniques.

4.2.5. Morphological Testing

(1) Scanning Electron Microscope. The surface morphology of the epoxy resin matrix bamboo fiber/rice husk/MWCNT filler interfaces scanning electron microscopy that was examined. The fractured mechanical surfaces were discussed and analyzed. Figures 9–11 show the morphology of the bamboo fiber/rice husk/1% MWCNT combination that revealed better bonding between the epoxy resin and hydroxyl ion. The dispersed matrix phase of these nanoparticles is dependent on agglomeration. Morphological analysis of the third specimen showed that it was evenly dispersed but filled with lumpy bamboo fibers. The incorporation of rice husk/MWCNT within the matrix provided better adhesion and interfacial locking of the reinforced composite. The fiber-epoxy interaction produced a very rigid material and moderate interface efficiency. Huang and Young [13] noted that the material exhibited poor interfacial adhesion between the epoxy resin and demonstrated significant fiber pull-out behavior at fracture surfaces. Tensile strength is higher for specimens 2 and 3 by the incorporation of MWCNT. Figure 10 (specimen 2) provides good fiber-matrix adhesion and fewer fiber pull-outs evaluated by tensile and flexural properties ranges, because the vacuum layup technique provides additional support to avoid air gaps, voids, and disregarding capillary action, but specimen 3 found some more voids and fiber pull-out in all the specific domains. The long pulled-out fibers from the specimen highlighted weak interfacial adhering causing stacking of filler at one place and poor matrix form in between the particle. Therefore, the mechanical performance is too poor in this case showed in Figure 11 (specimen 3).

5. Conclusions

From this study, the following conclusions can be drawn:

(1) Green composite materials with different weight concentrations of bamboo fiber/rice husk/MWCNT fillers were successfully developed, and their thermal conductivity and mechanical characterization were investigated

(2) The thermal conductivity of the hybrid composite decreased with the addition of natural fibers alone

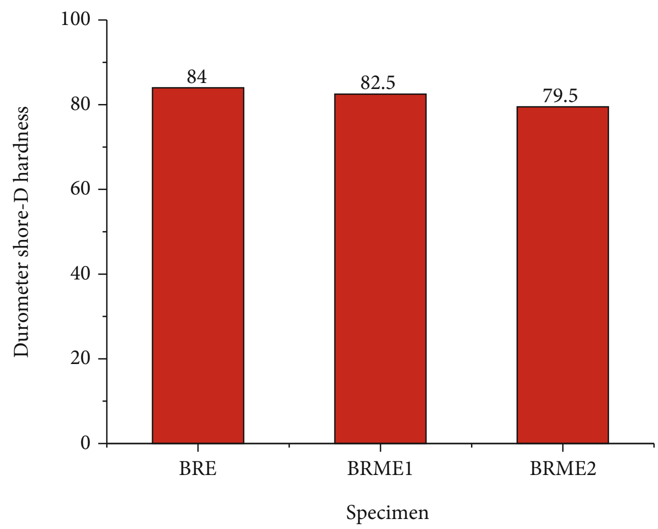

Figure 8: Durometer Shore-*D* Hardness vs. bamboo fiber composite.

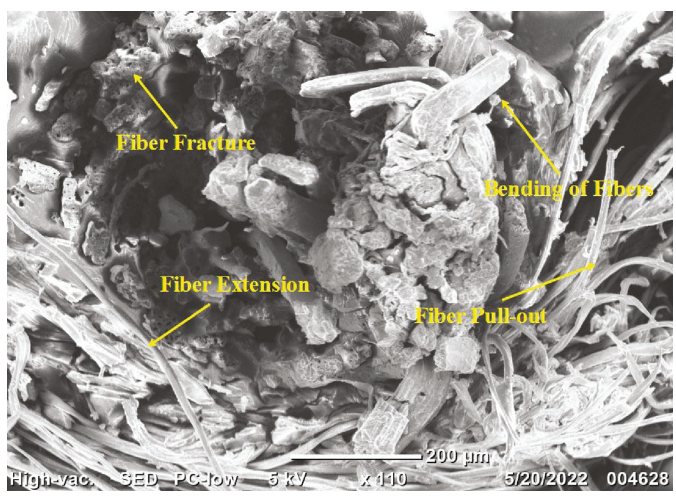

Figure 9: SEM image of the tensile-fractured surface bamboo fiber mat/coconut shell particle composite showing fiber bending, fracture, and pull-out.

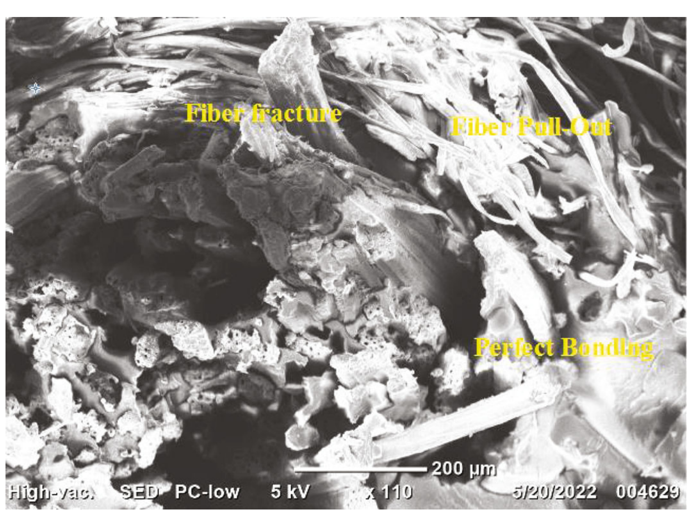

Figure 10: SEM image of the tensile-fractured surface bamboo fiber mat/coconut shell particle composite showing fiber fracture and pull-out.

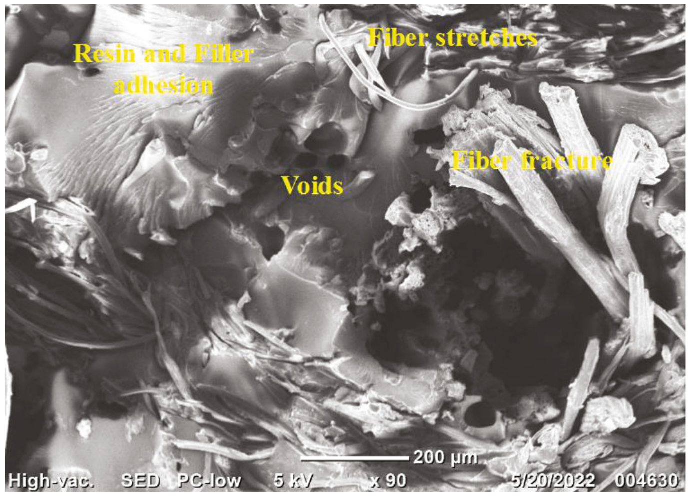

Figure 11: SEM image of the tensile-fractured surface bamboo fiber mat/coconut shell particle composite showing filler adhesion, voids, fiber fracture, and pull-out.

in specimen 1. With the addition of 0.5% and 1% MWCNT in specimens 2 and 3, the thermal conductivity of the composite varied from 0.2061 W/mK to 0.2577 W/mK

(3) The hybridization of natural fiber with the reinforcing effect of MWCNTs in epoxy composites has achieved maximum thermomechanical properties. Maximum tensile and flexural strengths were achieved for the 0.5% MWCNT hybrid composite at 40.66 MPa and 54.72 MPa, respectively

(4) The SEM images revealed that the interfacial adhesion between the particles and the addition of MWCNT integrated the microparticle into the nanoparticle to create a continuous bond between the particle to give a good crystalline structure and propagation of the fiber fracture also uniform, but specimen 3 has more fiber extension, fiber elongation, fiber breakage, voids, and fewer filler matrix deposits (fewer agglomeration)

Data Availability

The data used to support the findings of this study are included within the article. Should further data or information be required, these are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Acknowledgments

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