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Retraction

Retracted: Mechanical and Morphological Studies of *Sansevieria trifasciata* Fiber-Reinforced Polyester Composites with the Addition of SiO_2 and B_4C

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] P. Hariprasad, M. Kannan, C. Ramesh et al., "Mechanical and Morphological Studies of *Sansevieria trifasciata* Fiber-Reinforced Polyester Composites with the Addition of SiO_2 and B_4C," *Advances in Materials Science and Engineering*, vol. 2022, Article ID 1634670, 5 pages, 2022.

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Research Article

Mechanical and Morphological Studies of *Sansevieria trifasciata* Fiber-Reinforced Polyester Composites with the Addition of SiO_2 and B_4C

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The impact of SiO_2 and B_4C on mechanical and morphological studies of *Sansevieria trifasciata* fiber (STF) reinforced in polyester composites is investigated in this study. STF fibers are reinforced with polyester composites with the addition ceramic fillers such as SiO_2 and B_4C in various weight fractions to improve tensile, flexural, and impact characteristics. The morphological properties are studied with the help of scanning electron microscopy (SEM). The improved mechanical properties were tensile strength (44.92 MPa), flexural strength (103.58 MPa), and impact strength (27.4 kJ/m^2) obtained for 20 wt.% STF fiber and 15 wt.% SiO_2 reinforcement with the polyester matrix. The mechanical characteristics of the composites were significantly influenced by increasing SiO_2 up to 15 wt.%.

1. Introduction

Natural fiber-reinforced composites (NFRC) have been more important in specialized applications ranging from sports to biomedicine and the military in recent decades. Automotive industries, sporting goods, and structural components are dominated by composites derived from petroleum-based synthetic fibers. Synthetic fibers are often used in a variety of sectors due to their excellent mechanical qualities and inexpensive cost. These fibers, on the other hand, have several drawbacks, including high cost, causing environmental pollution by emitting greenhouse gases [1]. When petroleum-based goods are burned, a large quantity of CO_2 is released into the atmosphere. Natural fibers are gradually replacing petroleum-based fibers due to concerns about the environment, sustainability, and the need for biodegradable and energy-efficient products [2, 3]. Jute, sisal, kenaf, and hemp are some of the frequently used natural fibers [4–7]. Natural fibers derived from plants are mostly composed of various elements (cellulose, hemicellulose, lignin, etc.) [8, 9]. Compared to synthetic fibers, natural fibers have numerous advantages including light density, low cost, simple availability, biodegradability, recyclability, easy processing, and minimum health concerns [10, 11]. Meanwhile, they need to improve the following properties such as matrix fiber adhesion, thermal stability, and mechanical strength [12]. When compared to synthetic fiber composites, poor matrix fiber adhesion is the major reason for inferior mechanical properties. Since researchers' primary aim was improving matrix fiber bonding by doing various chemical modification techniques [13, 14], various chemical treatments are used to treat natural fibers in order to improve their interfacial contact with the matrix [15, 16]. Furthermore, adding ceramic fillers to resin improves the mechanical characteristics of composite materials, resulting in increased efficiency and cost savings [1, 17–20]. When compared to composites without silica, mudar/snake grass/polyester composites with silica had 1.5 and 1.08 times the tensile strength and modulus, respectively [18, 21]. The flexural and impact properties of jute/B4C have been improved by adding 30 and 10% wt.% jute and alumina, respectively [22, 23]. The inclusion of silica raised the impact values of bamboo fiber-reinforced composites up to a certain point, beyond which they dropped [24, 25]. B_4C and SiO_2 are often employed as possible fillers for different thermoset composites since they are the least expensive of all ceramics. The current study looks at how SiO_2 and B_4C affect the morphological and mechanical characterization of STF fiber reinforced with polyesters. Five samples were fabricated by varying the ceramic fillers in terms of weight proportions from 0–20%.

2. Materials and Methods

2.1. Materials. STF leaf fibers were collected and extracted from the local region of the Coimbatore district. The cellulose content of this fiber is around 56% and high hemicellulose of 35% with a low lignin content of 6% [26]. The better composite is obtained from the base of the finer since the fiber performance is comparatively good. So, the expectation on the fiber composite is unavoidable. The required ceramic filler and chemical SiO_2, B_4C, polyester resin, and catalyst (MEKP) were procured from Covaiseenu chemicals, Coimbatore. Testing and characterizations were done at KIT-Kalaignar Karunanidhi Institute of Technology, Coimbatore. The images of the fillers such as B_4C and SiO_2 are shown in Figures 1 and 2.

2.2. Treatment with Chemicals. Poor interface bonding is thought to be a typical issue with polymer matrix composites. This problem can be rectified by doing chemical treatment. The most commonly used surface treatment is NaOH for removing unwanted materials such as dust and wax from the surface of the fiber which improves the fiber-matrix bonding. This strengthens the interfacial connection between natural fibers and matrix, which increases the composite's overall mechanical properties. The fiber was rinsed with clean water to remove contaminants and dirt. The rinsed fibers were dried in the open air for 24 hours, then subjected to treatment for 3 hours in NaOH solutions. After that, the fibers were dried in an oven at 80°C for 4 hours. Alkaline solutions have the effect of removing hydroxyl groups from the fiber. FRC's interface strength and mechanical properties have also been significantly increased by alkaline treatment.

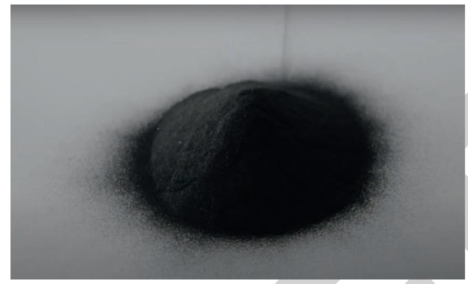

Figure 1: Image of B_4C.

Figure 2: Image of SiO_2.

2.3. Composite Preparation. The selection of fiber and volume fractions is the major factor that impacts the mechanical performance of the fabricated samples. To manufacture the composites, current research employs an STF short fiber (20%) reinforced in a polyester resin (60 wt %) as a continuous phase, with the addition of 20% of ceramic fillers such as SiO_2 and B_4C. The mold is polished first, and then wax is added to the surface to make it easier to remove the composite from the mold. An electromagnetic stirrer evenly agitates the polyester resin distributed with ceramic fillers. The ceramic filler polyester resin was poured into the mold. Subsequently, the mold was placed in a compression molding setup. The temperature was kept at 30°C, the pressure was kept at 35 bar, and it was maintained in the same conditions for 60 minutes. The samples were subjected to post-curing for 120 minutes. The manufacturing approach and process layout of composites are very unique and certain.

2.4. Characterization of the Prepared Composite with Different Experiments. In the present study, tensile (ASTM D3039) and flexural tests (ASTM D790) are performed using a computer-controlled universal testing machine (UTM). Tensile and flexural tests were performed on specimens with dimensions of $250 \times 25 \times 3$ mm and $125 \times 12.7 \times 3$ mm, respectively. Both experiments were carried out at a crosshead velocity of 20 cm/min. The notched impact strength was measured by the Charpy impact testing procedure. The ASTM D 256 impact test standard was used, and the specimen dimensions were 60×12 mm. Using the flexural test results, the following equation is used to calculate the interlaminar shear strength.

$$\mathrm{ILSS} = \frac{3F}{4bt}, \tag{1}$$

Table 1: Prepared composite materials.

Sample code	Matrix	Fiber	SiO_2	B_4C
*C*1	60	20	20	0
*C*2	60	20	15	5
*C*3	60	20	10	10
*C*4	60	20	5	15
*C*5	60	20	0	20

Table 2: Derived results from the experiment.

Sample code	Tensile strength	Flexural strength	Impact strength	ILSS
*C*1	38.15	88.32	19.4	3.41
*C*2	44.92	103.58	27.4	4.11
*C*3	43.46	99.09	23.2	3.67
*C*4	37.73	95.28	21.7	3.43
*C*5	35.60	84.73	16.6	2.99

where F is the braking load in N and b and t are the specimen's cross-sectional dimensions.

SEM is used to examine the specimens' fracture surface morphology. The fiber and matrix interface strength were determined using SEM analysis. Specimens were painted silver on an aluminum counterfoil before the morphological study, which was then sputtered with gold. During the observation of the sample, the coating inhibits the buildup of static electrical load. Testing was carried out at standard atmospheric conditions. The prepared sample list is displayed in Table 1 and the obtained results are summarized in Table 2.

3. Results and Discussion

3.1. Tensile Strength. Figure 3 depicts the impact of SiO_2 and B_4C on the tensile properties of STF FRC. The inclusion of ceramic fillers in the composites significantly increased the tensile strength, according to the findings. This was found up to 15% SiO_2 because the polyester matrix transmits stress to ceramic fillers, resulting in an increased tensile strength. However, owing to the incongruity between SiO_2 and polyester with the STF fiber, the tensile strength of this content falls over an excess addition leads to poor matrix fiber bonding.

3.2. Flexural Strength. The effect of the addition of ceramics fillers in STF/polyester composites is shown in Figure 3. The flexural strength was determined to be the highest at 15 wt.% SiO_2 and 20 wt.% STF fibers' reinforcement. The flexural strength varies between 84.73 MPa and 103.58 MPa as the amount of SiO_2 varies between 0 and 20 wt.%. This improvement may be attributed to SiO_2 in polyester, which significantly increases agglomeration resulting in poor mechanical properties. Enhanced flexural strength of ceramics-filled composites might be attributed to the composites' improved resistance to fracture initiation and propagation. The composites' flexural strength and modulus are improved as a consequence. There is a decline in the impact strength beyond this 15%.

3.3. Impact Strength. Impact energy steadily rises in the composites until it reaches 15 wt.% and 20 wt.% STF (Figure 3). Because of the increase in SiO_2 from 0 to 20 wt.%, the composite's impact strength rose from 2.99 kJ/m^2 to 4.11 kJ/m^2. The use of ceramic fillers improved the composites' capacity to absorb impact energy. The impact strength falls beyond 15 wt.% SiO_2 content owing to agglomeration and a weak contact to the matrix. The poor impact strength reduces the dimensional stability of developed composites. This is the reason behind the drop in impact strength when the SiO_2 filler addition goes beyond 15 wt.%.

3.4. Interlaminar Shear Strength (ILSS). Sample C2 has a greater ILSS than the other samples as seen in Figure 3. This demonstrates that the polyester resin improves the adherence of the fillers and STF fiber. Furthermore, increasing the percentage of SiO_2 in the STF fiber from 0% to 20% enhances the ILSS, but increasing B_4C causes a drop in ILSS. The ILSS of a composite with 20% SiO_2 content drops from 4.11 MPa to 3.41 MPa without fail. This might be due to incompatibility of the ceramic filler with the fiber, as well as a lack of saturation of 20 wt.% SiO_2 with polyester.

3.5. SEM Analysis. According to SEM examination, a composite containing 15% SiO_2 may be homogeneously distributed in polyester because the uniform distribution matrix fiber bonding increased significantly. Mechanical properties were increased up to 15% SiO_2 concentration. When SiO_2 concentration rises beyond 15 wt%, agglomerates form, resulting in a reduced bonding strength. Beyond 15 wt.% SiO_2 concentration, reduced bonding

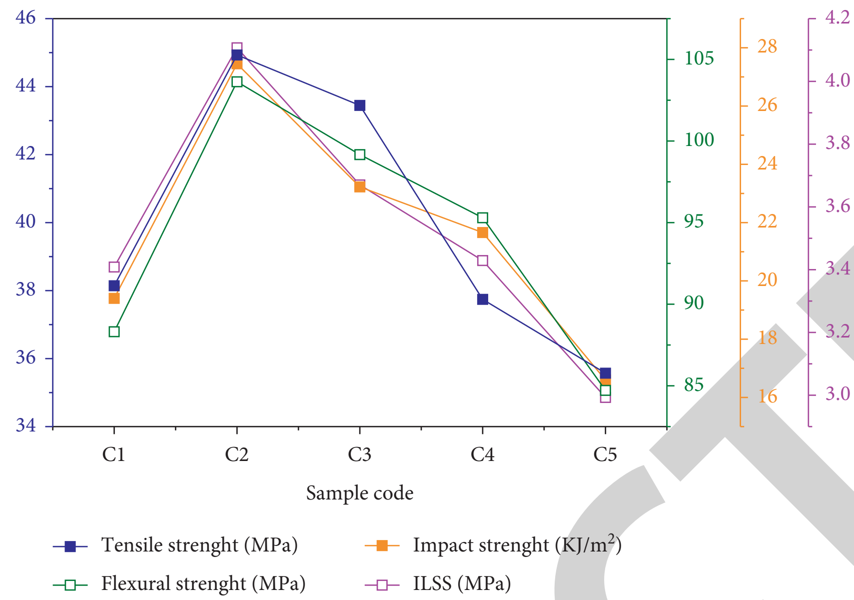

Figure 3: Mechanical test result after the experiment.

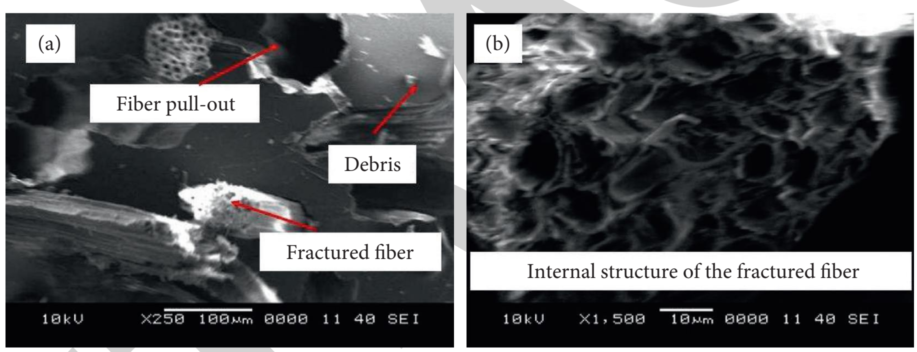

Figure 4: SEM images after tensile test. (a) SiO_2 15 wt.%. (b) SiO_2 20 wt.%.

between fibers and fillers with polyester shows deterioration in mechanical characteristics. Figure 4 shows SEM images of the fractured samples.

4. Conclusion

The experimental study of the effects of SiO_2 and B_4C on the mechanical characterization of STF polyester composites yielded the following results: The addition of SiO_2 and B_4C to STF fiber improves tensile, flexural, and impact strength greatly. When 0–20 wt.% SiO_2 and B_4C were combined with STF fibers, it was discovered that 15 wt.% SiO_2 produced the best mechanical qualities. Mechanical characteristics are reduced when the SiO_2 level exceeds 15% by weight. Increases in the ILSS have been seen when SiO_2 is added to the STF fiber from 0 to 15%; however, a drop in the ILSS has been observed when B_4C is increased. The fiber fracture mechanism has been studied by using SEM images and shows good transfer of the resin over the fiber interlaminar structure. As a result of their superior mechanical characteristics, the produced composites may be inferred to be a low-cost, lightweight, and environmentally friendly brake pad composite.

Data Availability

The data used to support the findings of this study are included within the article. Further data or information is 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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