An Approach of Nano-SiC-Filled Epoxy Nanocomposite Tensile and Flexural Strength Enriched by the Addition of Sisal Fiber

SPECIAL ISSUE MANUSCRIPT Published: 14 March 2024

(2024) Cite this article

Journal of The Institution of Engineers (India): Series D

Aims and scope

Submit manuscript

R. Venkatesh, Damodharan Dillikannan, N. Ilavarasan, R. Muthu Kamatchi, A. Daniel Das, M. Ammaiappan, G. Arunkumar & Gopal Kaliyaperumal

Abstract

Natural fiber-developed composites possess a great potential for automotive panel applications because of their low specific weight, strength, and ease of recycling. Besides, these composites lack adhesive behavior and limited tensile and elongation behavior. The exploration of the current investigation is to produce the epoxy nanocomposite enclosures with 20 vol% of natural sisal fiber (5% NaOH treated) and its 3, 6, and 9 volume percentages of nano-silicon carbide (SiC) particles through thermally assisted injection molding route. The functional qualities of the hybrid epoxy composite are measured and related to epoxy composite manufactured by 20 vol% natural sisal fiber (SF). It outputs

experimental values of hybrid epoxy nanocomposite (epoxy/20 vol% SF/6 vol% SiC) exploited with excellent tensile stress of 54 MPa associated with 18% elongation percentage as well as maximum flexural strength of 76 MPa and greater than the measured value of epoxy composite with 20 vol% of SF.

Data Availability

All the data required are available within the manuscript.

References

1. R. Roopashree et al., Investigation and performance study of hibiscus sabdariffa bast fiber-reinforced HDPE composite enhanced by silica nanoparticles derived from agricultural residues. Fibers Polymers **24**, 2155 (2023)

Article Google Scholar

2. R. Venkatesh, R. Raguvaran, A. Murugan et al., Evaluation of thermal adsorption and mechanical behaviour of intralaminar jute/sisal/e-glass fibre-bonded epoxy hybrid composite as an insulator. Adsorpt. Sci. Technol. **19**, 1–6 (2023)

Google Scholar

3. M.R. Sanjay et al., Characterization and properties of natural fiber polymer composites: a comprehensive review. J. Clean. Prod. **172**, 566–581 (2018)

Article CAS Google Scholar

4. N.M. Nurazzi et al., A review on the mechanical performance of hybrid natural fiber polymer composites for structural applications. Polymers **13**(13), 2170 (2021)

Article CAS PubMed PubMed Central Google Scholar

5. F. Jahan, M. Soni, Effects of chemical treatment on mechanical properties of various natural fiber reinforced composite: a review. Mater. Today Proc. **46**(15), 6708–6711 (2021)

Article CAS Google Scholar

6. A.H. Elsheikh et al., Recent progresses in wood–plastic composites: pre-processing treatments, manufacturing techniques, recyclability and eco-friendly assessment. Clean. Eng. Technol. **8**, 100450 (2022)

Article Google Scholar

7. J.S. Chohan et al., Manufacturing techniques and applications of polymer matrix composites: a brief review. Adv. Mater. Process. Technol. **8**(1), 884–894 (2022)

Google Scholar

8. R. Petrucci et al., Tensile and fatigue characterization of textile cotton waste/polypropylene laminates. Compos. Part B Eng. **81**, 84–90 (2015)

Article CAS Google Scholar

9. M.Y. Khalid et al., Recent trends in recycling and reusing techniques of different plastic polymers and their composite materials. Sustain. Mater. Technol. **31**, e00382 (2022)

CAS Google Scholar

10. M.D. Kumar et al., Study on static and dynamic behavior of jute/sisal fiber reinforced epoxy composites. Mater. Today Proc. **46**(19), 9425–9428 (2021)

Article Google Scholar

11. S. Arumugam et al., Investigations on the mechanical properties of glass fiber/sisal fiber/chitosan reinforced hybrid polymer sandwich composite scaffolds for bone fracture fixation applications. Polymers **12**(7), 1501 (2020)

Article CAS PubMed PubMed Central Google Scholar

12. D. Getu et al., Production and characterization of bamboo and sisal fiber reinforced hybrid composite for interior automotive body application. Mater. Today Proc. **38**(5), 2853–2860 (2021)

Article CAS Google Scholar

13. J.D. James et al., Influence of bagasse/sisal fibre stacking sequence on the mechanical characteristics of hybrid-epoxy composites. J. Nat. Fibers **17**(10), 1497–1507 (2020)

Article Google Scholar

14. K. Yorseng et al., Accelerated weathering studies of kenaf/sisal fiber fabric reinforced fully biobased hybrid bio epoxy composites for semi-structural applications: Morphology, thermo-mechanical, water absorption behavior and surface hydrophobicity. Constr. Build. Mater. **235**, 117464 (2020)

Article CAS Google Scholar

15. S.S. Kumar et al., Determination of mechanical properties and characterization of alkali-treated sugarcane bagasse, pineapple leaf and sisal fibers reinforced hybrid polyester composites for various applications. Fibers Polymers **22**, 1675–1683 (2021)

Article Google Scholar

16. H.B. Rachid et al., Effect of nanocomposite rate on the crack propagation in the adhesive of single lap joint subjected to tension. Mech. Adv. Mater. Struct. (2023). https://doi.org/10.1080/15376494.2023.2240319

Article Google Scholar

17. B. Mylsamy et al., Innovative characterization and mechanical properties of natural cellulosic *Coccinia indica* fiber and its composites. Mater. Test. **62**(1), 61–67 (2019)

Article ADS Google Scholar

18. P. Raja Sekaran, Adsorption and photocatalytic degradation properties of bimetallic Ag/MgO/Biochar nanocomposites. Adsorpt. Sci. Technol. **2022**, 3631584 (2022)

Article Google Scholar

19. P.R. Sekaran, H. Ramakrishnan et al., Mechanical and physical characterization studies of nano ceramic reinforced Al–Mg hybrid nanocomposites. SILICON **15**(10), 4555 (2023)

Article CAS Google Scholar

20. N. Karthi, Synthesis and adsorbent performance of modified biochar with Ag/MgO nanocomposites for heat storage application. Adsorpt. Sci. Technol. **2022**, 7423102 (2022)

Article Google Scholar

21. W. Christraj, Performance analysis of solar water heater in multipurpose solar heating system. Appl. Mech. Mater. **592–594**, 1706–1713 (2014)

Google Scholar

22. S. Baskar, Thermal management of solar thermoelectric power generation, in *AIP Conference Proceedings*, vol. 2473, No. 1 (2022)

Funding

The authors did not receive support from any organization for the submitted work.

Author information

Authors and Affiliations

Department of Mechanical Engineering, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai, 602105, Tamil Nadu, India
R. Venkatesh

Department of Mechanical Engineering, Jeppiaar Engineering College, Chennai, 600119, India
Damodharan Dillikannan

Department of Civil Engineering, University College of Engineering, BIT Campus, Tiruchirappalli, 620024, Tamil Nadu, India
N. Ilavarasan

Department of Mechanical Engineering, School of Engineering, Vels Institute of Science Technology and Advanced Studies, Chennai, 600117, Tamil Nadu, India
R. Muthu Kamatchi

Department of Mechanical Engineering, Karpagam Academy of Higher Education, Coimbatore, 641021, Tamil Nadu, India
A. Daniel Das

Department of Civil Engineering, Rajalakshmi Engineering College, Chennai, 602105, Tamil Nadu, India
M. Ammaiappan

Department of English, Kongunadu College of Engineering and Technology, Trichy, 621215, Tamil Nadu, India
G. Arunkumar

Department of Mechanical Engineering, New Horizon College of Engineering, Bangalore, 560103, Karnataka, India
Gopal Kaliyaperumal

Corresponding author

Correspondence to Gopal Kaliyaperumal.

Ethics declarations

Conflict of interest

The authors have no competing interests to declare relevant to this article's content.

Ethics Approval

This is an observational study. An approach of nano-SiC-filled epoxy nanocomposite tensile and flexural strength enriched by the addition of sisal fiber: The Research Ethics Committee has confirmed that no ethical approval is required.

Additional information

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Rights and permissions

Reprints and permissions

About this article

Cite this article

Venkatesh, R., Dillikannan, D., Ilavarasan, N. *et al.* An Approach of Nano-SiC-Filled Epoxy Nanocomposite Tensile and Flexural Strength Enriched by the Addition of Sisal Fiber. *J. Inst. Eng. India Ser. D* (2024). https://doi.org/10.1007/s40033-024-00680-1

Received	Accepted	Published
03 February 2024	21 February 2024	14 March 2024

DOI
https://doi.org/10.1007/s40033-024-00680-1

Keywords

Epoxy | Flexural strength | NaOH | Nano-SiC | Sisal fiber | Tensile strength