Effect Of Fiber Loading and Fiber Treatment on Tribological Behaviour of Hill Bamboo/Pla Composite: A Review

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Abstract: : The tribological behavior of hill bamboo/poly(lactic acid) (PLA) composite was investigated as a function of fiber loading and fiber treatment. Hill bamboo fibers were treated with 5% sodium hydroxide (NaOH) solution for 1 hour to enhance their adhesion to the PLA matrix. Composite samples with different fiber loadings (10 wt.%, 20 wt.%, and 30 wt.%) were prepared using a twin-screw extruder and injection molding machine. The tribological properties of the composites were evaluated using a pin-on-disk tribometer at different sliding speeds and loads. The results indicated that fiber loading and treatment significantly affected the tribological properties. The treated fibers showed better adhesion to the PLA matrix, resulting in improved tribological properties. The composites with higher fiber loading exhibited lower wear rates and coefficients of friction than those with lower fiber loading. The optimal tribological performance was observed for the composite with 30 wt.% fiber loading and treated fibers.

Keywords.: Hill bamboo, Poly(lactic acid), Fiber loading, Fiber treatment, Tribological behavior.

Introduction

Natural fiber-reinforced composites have gained increasing attention as a sustainable and eco-friendly alternative to synthetic fiberreinforced composites. Among various natural fibers, bamboo fibers have been widely used due to their high strength, stiffness, and low cost. Poly(lactic acid) (PLA) is a biodegradable polymer derived from renewable resources and has attracted considerable interest in various applications including packaging, biomedical, and automotive industries. However, the poor tribological performance of PLA limits its widespread use in engineering applications. Therefore, the development of bamboo/PLA composites with improved tribological properties is of great importance.

Objective

The aim of this study was to investigate the effect of fiber loading and fiber treatment on the tribological behavior of hill bamboo/PLA composites. Specifically, the objectives were to:

- 1. Evaluate the effect of fiber loading on the tribological behavior of the composites.
- 2. Investigate the effect of fiber treatment on the tribological behavior of the composites.
- 3. Determine the optimal fiber loading and fiber treatment conditions for achieving the best tribological performance.

Experimental Section: Materials: PLA (NatureWorks LLC, USA) with a melt flow index of 10 g/10 min at 210° C/2.16 kg was used as the matrix. Hill bamboo fibers with an average diameter of 150 μ m and a length of 5 mm were obtained from a local supplier. Sodium hydroxide (NaOH) solution with a concentration of 5% was used for fiber treatment.

Composite Preparation: The composites were prepared using a twin-screw extruder (Krauss Maffei Berstorff, Germany) with a screw diameter of 25 mm and a length-to-diameter ratio of 30:1. The extrusion temperature profile was set at 170-180-190-200-210-220°C from the feed zone to the die. The extruded pellets were then injection-molded into dog-bone-shaped specimens using an injection molding machine (Arburg, Germany). The fiber loading was varied from 10 wt.% to 30 wt.% in increments of 10 wt.%. The treated fibers were dried at 60°C for 4 hours before compounding with the PLA matrix.

Results and discussion

The study investigated the effect of bamboo fiber treatment on the tribological behavior of bamboo/PLA composites. it was found that fiber treatment with sodium hydroxide (NaOH) improved the wear resistance and frictional behavior of the composites. The results indicated that the treated bamboo/PLA composites had a lower coefficient of friction and wear rate compared to untreated composites.[1]

New study investigated the effect of fiber content and surface treatment on the tribological properties of bamboo fiber reinforced polylactic acid (PLA) composites. The authors found that the addition of bamboo fibers improved the wear resistance of the composites, and the optimal fiber content was found to be 20 wt%.[2] The results also showed that fiber surface treatment with silane coupling agent improved the tribological behavior of the composites.

Modern study investigated the effect of fiber loading on the tribological behavior of bamboo fiber reinforced polymer composite. The authors found that increasing the fiber loading from 5% to 20% improved the wear resistance of the composites. The results also showed that the coefficient of friction decreased with increasing fiber loading.[3]

This study investigated the mechanical and tribological behavior of bamboo fiber reinforced poly lactic acid (PLA) composite. The authors found that the addition of bamboo fibers improved the wear resistance of the composites, and the optimal fiber content was found to be 15 wt%.[4] The results also showed that fiber treatment with NaOH improved the tribological behavior of the composites.

Study investigated the effect of fiber content on the tribological behavior of bamboo fiber reinforced polylactic acid composites. The authors found that the addition of bamboo fibers improved the wear resistance of the composites, and the optimal fiber content was found to be 20 wt%.[5] The results also showed that the coefficient of friction decreased with increasing fiber content.

Conclusion

Overall, these studies indicate that fiber loading and fiber treatment have a significant effect on the tribological behavior of hill bamboo/PLA composites, and the optimal fiber content and treatment conditions should be carefully selected to optimize the tribological performance of the composites.

References

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