Effect of Fiber Dosage and Chemical Treatment on the Vibrational Behavior of Luffa/ USP Composite

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Abstract In this work, the vibrational behavior of luffa cylindrica/USP composites has been addressed. The effect of fiber dosage with difference fiber content from 30, 40, 50% and chemical treatment (NaOH) are analyzed. The specimens are fabricated with compression molding technique with pressure of 17 MPa. For the production of composite specimens, untreated and NaOH treated fiber were used as reinforcement and unsaturated polyester resin (USP) used as matrix. The prepared specimens are cut as per the ASTM standard, and mechanical and vibrational tests were conducted. The experiential nodal analysis is used to fine the natural frequency and damping of the composites. The results depicts that the increase in fiber dosage started to improve the mechanical properties of the composite beam. The NaOH treatment showed the improvement in mechanical and damping of the composites. The 50% fiber dosage showed the good tensile and flexural properties of the composites. The interfacial mechanism of the composites was interpreted in the SEM.

Keywords Luffa · Natural fiber · USP · Natural frequency · Damping · Mechanical properties

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1 Introduction

Now a days the natural fiber have been much more attention by the researchers because of its good performance towards industrial applications. The natural fiber reinforced composite (NFRC) provides high specific strength, low cost, easy availability, and bio degradability [1–3]. The most commonly planet fiber used in various low load applications like mats, fishnets, mats and wall coverings are banana, jute, sisal, hemp, palmira, ramie, coir, flax [4]. Kumar et al. [5] examined that the impact of fiber dosage and sequence of sisal and banana fiber composites on mechanical and vibration characteristics and reported that maximum value of mechanical properties found on the 40% fiber dosage. In addition to that, the fiber dosage may affect the natural frequency of the composites. Senthilkumar et al. [6] analyzed that impact of length of fiber and fiber dosage on mechanical behavior and vibrations properties on banana/sisal composites and also they observed that increase in fiber dosage stared to enhance the mechanical and damping ability. Rajini et al. [7] researched on chemical modification effects on dynamics mechanical analysis along with vibration behaviors on coconut sheath and nano clay/USP hybrid composites and concluded that the vibration properties have been improved in 3 wt.% addition of clay in hybrid composites. Senthilkumar et al. [8] investigated stacking sequence impact on the vibration properties of short banana and woven coconut sheath/USP composites with effect of chemical treatment. Kalusuraman et al. [9] earlier concluded that the surface treatment impact on friction co-efficient of luffa/USP composites. Kalusuraman et al. [10] studied about the DMA studied on luffa/USP composites and reported the fiber loading enhances the storage modulus. From the literature, It can be revealed that the most of the researchers have done the vibration behaviors of the many natural fiber composite. But the natural behaviors of luffa/USP composite are scanty. On this context, the present work describes the vibration and mechanical properties of luffa/USP composite by varying fiber dosage with effect of surface treatment.

2 Experimental Details

In this study, luffa fibers are used supplied from local market. Unsaturated polestar resin, accelerator, and catalyst are supplied by Vasivibala resins Pvt. Ltd., Chennai, Tamil Nadu, India.

2.1 NaOH Treatment

The fibers were permitted to submerge in the alkali solution which was made by addition of 40 g of NaOH in 1000 ml distilled water for an hour. After that the fibers

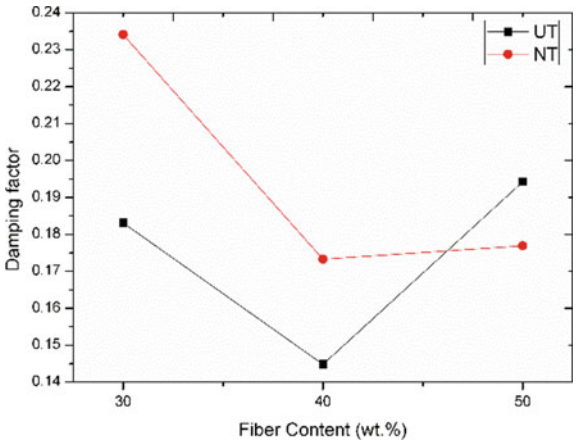

Fig. 6 Effect of fiber dosage, and surface treatment on damping behavior

Table 3 Damping of the Luffa/USP composites

Damping	Composite types					
	UT 30	UT40	UT 50	NT30	NT40	NT50
Mode1	0.183134	0.144839	0.19427	0.234093	0.173269	0.176912
Mode2	0.026788	0.023385	0.030698	0.034874	0.028158	0.026168
Mode3	0.012412	0.008812	0.011158	0.012647	0.009631	0.009460

loading will lead the higher damping ratio since their viscous elastic behaviour in nature. However, it is observed that higher fiber dosage gives high damping. It is in contradiction for luffa/polyester composites. The porous structure of the fiber may also be the reason for higher damping. The measured damping values of the UT and NT composites are very similar in mode-1 rather than mode-2 and mode-3. From the Table 3, it is clear that other than the fiber dosage, interface stiffness is also the most significant factor on the damping behaviour. The NT composite holds the higher damping than UT composite. The surface treatment improves the surface roughness which increases the interface bonding.

4 Conclusion

This work reports the effect of fiber dosage and chemical treatment on the vibrational behavior of Luffa/ USP composite. The following conclusions were drawn:

- The luffa /USP composite were successfully produced by using the compression moulding process by varying fiber dosage.
- Better mechanical properties were found for the NT composite in comparison with the UT composite.

- The higher fiber loading (50%) gives significant improvement on tensile and flexural properties of the composites.
- The optimum fiber dosage was observed as 50% for luffa/polyester composites.
- The maximum natural frequency was found for NT40 composite. In addition, the NT40 composite offers higher damping values among all the types of composites.

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