



Influence of sodium bicarbonate treatment on the free vibration characteristics of *Phoenix* sp. fiber loaded polyester composites

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ABSTRACT

Natural fiber-based polymeric composites have become increasingly popular in machine tool and automobile applications in recent years. While, using the composite in such applications, it may fail due to excessive vibrations caused by dynamic loads. Therefore, it is necessary to understand the free vibration behavior of composites before employing it to such applications. The purpose of this work is to compare the free vibration characteristics of untreated and sodium bicarbonate treated *Phoenix* sp. fiber reinforced polyester composites fabricated through compression molding technique with different fiber content (0, 10, 20, 30 and 40 wt.%) and constant fiber length (20 mm). The chemical treatment was carried out for different time periods (24, 120 and 240 h) with 10 wt.% concentration of sodium bicarbonate solution. The results revealed that the natural frequency of treated fiber composites was greater than the untreated fiber composites which maybe ascribed to the increased stiffness of the fibers and interfacial bonding after the treatment. In addition to this single fiber pull-out test was also performed to assess the interfacial strength among the composite constituents. Especially, the composites loaded with 120 h treated fiber showed better results and it can be suggested for various engineering applications. Copyright © 2021 Elsevier Ltd. All rights reserved.

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1. Introduction

The usage of natural fibers as reinforcement material for the fabrication of polymeric composites increased in recent years, due to its favorable properties such as renewable, non-toxic, biodegradable, low density and is available in abundance [1,2]. The composites produced using such fibers offer high strength to weight ratio, adequate thermal and acoustical insulation properties, considerable damping characteristics, simple manufacturing methods and low cost [3]. While employing the composites in structural applications it may subject to the dynamic loads which cause vibration in the structures. Therefore, the understanding of free vibration behavior is much essential to prevent the composites from failure due to vibrations [4].

To this aim, Ramakrishnan et al. [5] produced the epoxy composites using raw and NaOH treated jute fibers and investi-

gated their free vibration characteristics. The outcomes revealed that, the composites added with treated jute fibers performed better than the untreated fiber incorporated composites. Similarly, in another work the influence of NaOH treatment on the vibration behavior of natural fiber loaded polymeric composites was investigated and reported that after chemical treatment the performance of the composites improved due to the better interfacial bonding [6]. The improvement in the free vibration characteristics of polymers composites added with alkali and silane treated coconut sheath fibers [7] and NaOH treated *Phoenix* sp. fibers [4] were reported in the literature.

Phoenix sp. is one of the plants growing in India and it has huge amount of fibers in the petioles, which are being wasted during the maintenance of plants. To the best of authors knowledge, no literature report the free vibration characteristics of the sodium bicarbonate treated *Phoenix* sp. fiber reinforced polyester composites. Therefore, in the present work, the first three modal frequencies of raw and sodium bicarbonate treated *Phoenix* sp. fibers added polyester composites were investigated as a function of fiber con-

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