Materials Research Express

PAPER

Mechanical and dynamic mechanical properties of hybrid kevlar/ natural fiber composites

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Keywords: kevlar fibre, hybrid composites, dynamic mechanical analysis, mechanical p roperties

OPEN ACCESS

RECEIVED
6 July 2023

REVISED
26 September 2023

ACCEPTED FOR PUBLICATION
12 October 2023

PUBLISHED
20 October 2023

Abstract

The current experiment aimed to identify the characteristics of composite materials enhanced with aloe vera, bamboo, palm, and kevlar fibres. Three different types of combinational fabrication—Type I (a blend of aloe vera and bamboo), Type II (a combination of bamboo and palm), and Type III—were carried out from all the other them (blend of palm and aloe vera). Analysis was done on the mechanical and dynamic-mechanical evaluation of biocomposites made spontaneously. Natural fibres used to produce hybrid composites were alkaline and treated in a 2.5 ml NaOH solution for 6 h at room temperature to get acceptable characteristics, then dried to remove the wax and oils on the natural fibre's exterior surface. The effect of different stacking sequences on the mechanical and dynamic properties of manufactured composites has been investigated experimentally through ASTM standards. Impact, inter-delamination and double-shear tests are used to evaluate the mechanical properties; the failure mechanisms of the fabricated hybrid composites with various stacking sequences and testing conditions were investigated through the fractographs of SEM analysis. Type I S1 samples were found to display significant impact energy (10 Joules) as compared to other samples, and the break load of composite specimens was higher at 4.5 KN in S2 samples of type-III as compared to type-I and II, revealed Type-I samples with significant peak area of 0.492 delivered at 102.01 °C as compared to two types, Type-3 (Palmyra Palm + Aloe Vera) composite gave the best mechanical, dynamic properties.

1. Introduction

Natural fibre-reinforced composite materials are widely used in the automotive industry and manufacturing sector; natural fibres are extracted from plants and trees, natural fibre composite materials are biodegradable and eco-friendly, and different natural fibres are used for domestic and aerospace interior parts. Natural fibres used in composite materials are typically sourced from renewable resources such as plants (e.g., flax, hemp, jute, bamboo) or animals (e.g., wool, silk) [1, 2]. These fibres possess several advantageous properties, including high specific strength, low density, biodegradability, and natural abundance. They are often used in the form of fabrics or yarns. Natural fibres are derived from various plant and animal sources, serving as an essential element in human civilization's historical and modern fabric manufacture. These fibres have been employed for numerous millennia in producing textiles, ropes, and an extensive range of other commodities. Natural fibres commonly used include cotton, flax (or linen), silk, wool, and jute. These materials exhibit unique attributes,