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Dynamic analysis of the natural fiber (Coir) reinforce polyester composite material with mechanical properties

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Abstract

The primary goal of the research determines the mechanical and damping property of the composite material made of polyester, short coir fibres under dynamic analysis at various temperatures and frequencies. It has been discovered how temperature affects storage modulus (E′), factor defeat or damping efficiency and loss modulus (E″). The specimen of the composites is constructed using a hand-layup process with random fibre orientation, with weight percentages of 5, 10, 15, and 20%. The research tests showed that adding more fibre raise the mechanical properties and storage modulus, with highest value being provided by composites with fibre loads of 5, 10, 15 and 20wt% respectively in different temperature. The fibre content decreases the maximum height of the loss modulus and damping curve (tan). The attribute is likened to clean polyester. The study finds the increased fibre contents increase along with composite's natural frequency and storage modulus.

Introduction

The natural fibre composites are real another to the artificial fibre composites in a number of applications, while the fibre has a number of comparative advantages, including lower density, greater specific strength, lower cost, and renewability. Coir, sisal, flax, cotton, hemp, ramie, and other plant fibres that have historically made contributions to various fields are among the most often utilised plant fibres for polymer reinforcement. The general foundation of combined resource recitals is automatic distinctiveness, like compression, tensile, impact and flexural qualities. Uniqueness is a must to determine material performances in variety of situations. Although it has not been adequately researched for structural engineering, particularly in conditions with dynamic loads. Due to its impact on system capabilities like reliability and safety, damping is a crucial role associated with lively carried of the material [1], [2], [3], [4].

Because of stress–strain, early wear, and hazardous working conditions, the vibrations increase the noise level. When a forceful loading generates vibration at the material's normal incidence, the structures may experience excessive pulsation. In order to effectively construct and use this composite, it is crucial to take into account all of the material's mechanical properties [5], [6], [7], [8]. The vibration type damping in polymer is the subject of the majority of the modifications. However, the FRP material's damping mechanisms are different from those of a typical polymer [9], [10], [11], [1]. (see Table 1, Table 2).

The presence of a filler or strengthening medium in a composite material expresses a multi-part interior structure in which the damping performances rely on a variety of factors, including volume fraction, interface quality, plasticization of the polymer, and load direction, in addition to the properties of the individual materials [12], [13], [14], [15], [16]. The fibre-reinforced composite has a variety of energy tolerance mechanisms, including viscoelastic matrix properties, fibre materials, the friction generated by matrix slide, energy allowance at cleft and delamination cause by dented places, viscosity, thermal elastic and plastic damping [17], [18], [19], [20], [21].

Section snippets

Tensile test

This (TGST) involves applying tension to a specimen up to a predetermined limit [22], [23], [24], [25], [26]. The test results are mainly used for quality control, selecting a material for a certain application, and analysing how the material will respond to various stresses [27], [28], [29], [30]. The greatest elongation, area reduction, and ultimate tensile strength are characteristics that the help tensile test directly measures (see Fig. 1, Fig. 2)….

Tensile strength

The tensile tests of 5 to 20% of coir fibers could be tested in different sample, and the value as follows: Maximum load (3500N), crushing load (1264N), the maximum stress of 20.68N/mm^2 and breaking stress of 8.826N/mm^2. It can be deduced that the 20 percent ratio of coir fibre have greater maximum strength when compared to the previous Fig. 4….

Rockwell hardness test

Fig. 5 gives hardness test data for 5 to 20 percentage of coir and 95, 90, 85 & 80 percentages of the resin that test various sample. The applied…

Conclusion

In this work, tensile, DMA, and hardness tests are used to assess various properties and damping properties of the small coir fibre reinforce polyester composites. It has been determined that adding coir fibre improves the mechanical properties. It should be noted that adding 5wt% of coir fibre to the composite material resulted in the greatest storage modulus value of 1.53E+10Pa, while adding 20wt% of coir fibre to the material resulted in the lowest modulus value of 7.93E+08Pa. The…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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