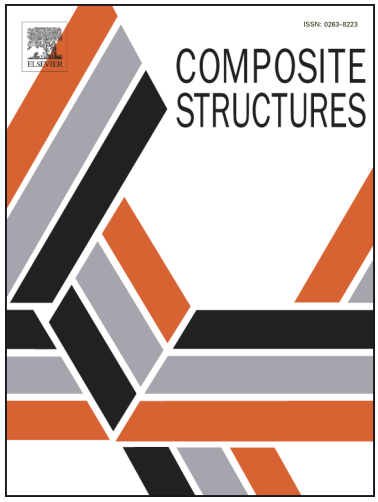

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Morphology, static and fatigue behavior of a natural UD composite: the date palm petiole 'wood'

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Abstract

Large quantity of date palm wastes annually accumulate in Algeria. We investigate date palm petiole wood (DPPW) and macroscopic fibers from northern and southern Algeria by X-ray tomography, monotonic tension and compression, microscopy analysis, and fatigue tensile tests. DPPW is a unidirectional composite ($V_F = 25\,\%, \rho = 210\,\mathrm{kg\,m^{-3}}$) consisting of a fibrovascular ultrastructure (reinforcement) and parenchyma (matrix). Mechanical properties of southern DPPW ($E = 0.5\,\mathrm{GPa}$, $\sigma^u = 6\,\mathrm{MPa}$, $\varepsilon^u = 1.75\,\%$) are higher than northern ones because of the dry climatic conditions, its density also is higher. Main failure modes are cell-wall tearing and spheroidal-cell detachment (parenchyma), and pull-out or net fracture (fibers). Stress ratio is the major fatigue parameter, $R = 0.125$ is a limit of endurance for transverse southern DPPW. High mechanical homogeneity of DPPW along that direction reduces the risk for damage development. Thanks to limited density, high fatigue life, and neglectable cost, DPPW is a good candidate for local development of sandwich core.

Keywords: Date palm; Petiole wood; Fatigue; Morphology

1. Introduction

In recent years, plant based materials are drawn considerable attention as substitute candidate for synthetic materials. This is mainly due to their possible advantages, *i. e.* low cost, low weight, few damage to processing equipment, improved surface finish of molded parts [1][2], good specific mechanical properties, abundant and renewable resources. A major advantage is that they can be easily disposed of at the end of their life cycle by composting or by recovery of their calorific value in a furnace, particularly when the matter is $100\,\%$ bio-based. However, plant based materials also exhibit some undesirable characteristics, like high moisture absorption, low thermal resistance

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