Dynamic Properties of Plant Fiber Reinforced Composite Plates Based on Experimental and Numerical Method

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Abstract

Plant fiber reinforced composites (PFCs) have been a better environmental choice for engineering application such as vehicle, aircraft and other transportation. This paper presents the damping identification of plant fiber reinforced composites. Meanwhile, the effect of resin and woven structure on dynamic properties of flax fiber reinforced composites (FFRC) and hemp fiber reinforced composites (HFRC), respectively. Three kinds of polymer, petroleum-based epoxy, polypropylene (PP) and polylactic acid (PLA), with unidirectional (UD) flax fiber are manufactured into composite plates. Dynamic properties of FFRC are obtained by experimental (resonance and non-resonance method) and numerical investigation. A numerical model is implemented to simulate the dynamic behavior of UD composites by using an orthotropic material model, and the deformation is supposed in a linear elastic stage. Dynamic mechanical analysis (DMA) tests using hemp-green epoxy composite plates in three different woven structures including plain, twill and satin are carried out to identify their damping properties. The damping performance of pure resin and flax composites obtained from different experiments are compared. A multi-scale approach is proposed to predict the local damping properties since it is difficult to understand the effect of each component in the composite materials using a global method.

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