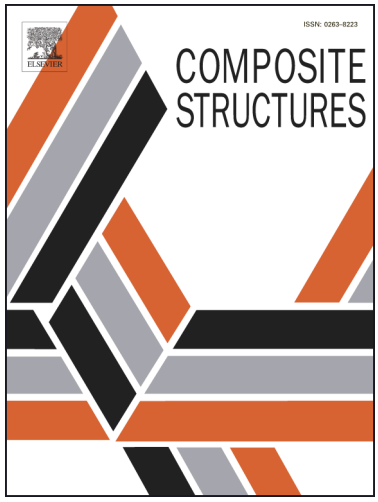

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Modeling of natural fiber reinforced composites under hygrothermal ageing

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Abstract

In this paper, we focus on the mechanical performance of fibers naturally derived from plants as reinforcement of a composite structure. A nonlinear constitutive model for the whole hygrothermal ageing process of natural fiber reinforced composites is established. This theoretical model accounts for large elastic and inelastic deformation, diffusion of water molecules and hydrolysis reaction. Based on the non-equilibrium thermodynamic framework, the Helmholtz free energy functions and the corresponding dissipation laws are established. The effects of matrix cracking, fiber-matrix interfacial debonding and change in the microstructure of natural fibers are all considered in this theoretical model. And the competition between the loss and the recovery of mechanical properties of natural fibers is investigated. Moreover, this theoretical model is applied to analyze the elastic response of natural fiber reinforced composites and the influence of ageing temperature is discussed. The obtained theoretical results are compared with corresponding experimental data and it is shown that the present theoretical model is capable of describing the evolution of elastic moduli of composite samples and their temperature dependence during the whole hygrothermal ageing process.

Keywords: Natural fiber reinforced composite; Hygrothermal ageing; Nonlinear constitutive model; Free energy; Dissipation

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