Determination of Effective Characteristics of the Fibrous Viscoelastic Composite with Transversal and Isotropic Components

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The method of determining the parameters of the integral operator of the effective longitudinal elastic modulus of the first-kind composite material is proposed. The viscoelastic transversal and isotropic composite with a periodic structure is used as an object of study. The elements of its cell are the transversal and isotropic viscoelastic matrix and the elastic fiber, which are approximated by hollow and solid cylinders, respectively. The rheological matrix characteristics are described according to the Boltzmann–Volterra hereditary theory. The axisymmetric longitudinal tension of the cell is considered. It is assumed that the radial displacements and stresses on the border between the matrix and the fiber are continuous, the lateral surface of the cell is free from stresses, and axial deformations of the matrix and the fiber coincide. The Laplace transform is applied to solve the obtained boundary value problem. The similar problem in image space is solved for the homogeneous transversely isotropic viscoelastic composite. The effective instantaneous longitudinal elastic modulus and the relaxation kernel are determined via the relation between deformation of the composite and its components, namely the equality of their axial deformations. The proposed method allows one to determine the viscoelastic composite characteristics via the corresponding characteristics of its elements and the volume fractions of the matrix and the fiber in the composite material.

Keywords

composite material matrix fiber longitudinal tension viscoelasticity effective characteristics instantaneous elastic modulus relaxation kernel

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