Koeller, R. C.

Applications of fractional calculus to the theory of viscoelasticity. (English) Zbl 0544.73052

J. Appl. Mech. 51, 299-307 (1984).

Summary: The connection between the fractional calculus and the theory of Abel's integral equation is shown for materials with memory. Expressions for creep and relaxation functions, in terms of the Mittag-Leffler function that depends on the fractional derivative parameter β, are obtained. These creep and relaxation functions allow for significant creep or relaxation to occur over many decade intervals when the memory parameter, β, is in the range of 0.05–0.35. It is shown that the fractional calculus constitutive equation allows for a continuous transition from the solid state to the fluid state when the memory parameter varies from zero to one.

MSC:

74D05	Linear constitutive equations for materials with memory
74D10	Nonlinear constitutive equations for materials with memory
74R05	Brittle damage
74Hxx	Dynamical problems in solid mechanics
45E10	Integral equations of the convolution type (Abel, Picard, Toeplitz and Wiener-Hopf type)

Keywords:

Rabotnov theory; hereditary; spring-pot combined with springs; fractional polynomial operator; connection; fractional calculus; theory of Abel's integral equation; materials with memory; Mittag-Leffler function; continuous transition; solid state; fluid state

Full Text: DOI