Modeling Rate Dependency and Relaxation Behavior of Semi-Crystalline Polyamide 6

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Abstract

In this study, the influence of the degree of crystallinity on the mechanical behaviour of semi-crystalline polyamide 6 is investigated. To describe the long-term and time-dependent mechanical response of polyamide 6, a phenomenological constitutive model of finite viscoelasticity, motivated by the 1D rheological generalized Maxwell model is used. To account for strain rate dependency, a nonlinear viscous evolution equation is proposed. On the experimental side, polyamide 6 was melt-mixed with amorphous cyclic olefin copolymer to produce blends representative of polyamide 6 with varying degrees of crystallinity (from 15% to 29%). Various isothermal tests, including monotonic tension, relaxation and cyclic tests at temperatures above the glass transition temperature, were performed on the blends to generate a material database. The time-temperature superposition principle is used to obtain the viscoelastic behaviour over an extended period. Initial computations indicated the model could reliably predict the viscoelastic strain rate-dependent loading and relaxation behaviour across different crystallinity levels and temperatures.

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sciencesconf.org:esmc2025:593542