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ABSTRACT:

Environmental Influences on PA 6: Moisture and UV Effects on Thermoviscoelastic Response

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Polyamide 6 (PA 6) components generally operate under environmental conditions where humidity [1,2] and ultraviolet (UV) radiation affect stiffness, viscoelastic dissipation, and long-term mechanical performance. Reliable constitutive descriptions therefore require a clear separation of moisture-induced plasticization and UV-driven degradation mechanisms [3]. This study investigates environmental aging effects on the thermoviscoelastic response of PA 6. Hydrothermal conditioning is analyzed for moisture states ranging from dry-as-molded to fully water-saturated samples. Dynamic mechanical analysis (DMA), including relaxation and temperature–frequency tests, reveals moisture-dependent softening and shifts in the relaxation spectrum. UV-driven aging is examined on moisture-equilibrated PA 6 exposed to controlled irradiation. Gel permeation chromatography (GPC), differential scanning calorimetry (DSC), and DMA link molecular degradation to macroscopic thermoviscoelastic behavior. Short-term UV exposure increases stiffness with minor changes in molar mass and crystallinity, whereas prolonged irradiation causes chain scission, reduced stiffness, and increased viscoelastic dissipation. Master curve construction shows that environmental aging alters the relaxation spectrum and limits the applicability of time–temperature superposition, providing an experimental basis for constitutive modeling of PA 6 under environmental aging.

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