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ABSTRACT

Hysteresis and Viscoelastic Properties of P(3HB)/P(3HB-co-4HB) Monofilaments Under Cyclic Loading

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The mechanical performance of bio-based P(3HB)/P(3HB-co-4HB) monofilaments under cyclic loading was investigated to evaluate their hysteresis behavior and viscoelastic properties. Single-fiber tensile tests with cyclic loading and varying rest periods were conducted to analyze strain recovery, energy dissipation, and time-dependent deformation. The influence of different loading rates and relaxation times was examined to quantify the extent of viscoelastic recovery and plastic deformation. The results indicate significant hysteresis effects, characterized by a progressive shift in the stress-strain curves, suggesting viscoelastic and irreversible plastic deformation.

Recovery experiments showed that strain partially reverses over time, with a time-dependent relaxation effect. The incorporation of β-tricalcium phosphate (β-TCP) increased fiber stiffness but reduced ductility, affecting the long-term mechanical stability. Furthermore, cyclic loading experiments revealed a correlation between the loading conditions and the energy dissipation capacity of the fibers, which plays a crucial role in their fatigue behavior.

These findings provide insights into the deformation mechanisms of biodegradable fibers under repeated mechanical stress, supporting their potential application in technical textiles. The study highlights the need for further optimization of fiber composition and processing conditions to enhance their durability and mechanical resilience, particularly in applications requiring high flexibility and resistance to cyclic stress.