Compounding and Melt-Spinning of PHB Blends for Fiber Applications

Aybige Özkan*†[1] and Asli Hockenberger[2]

[1]KORTEKS – Turkey
[2]Bursa Uludağ Üniversitesi – Turkey

Abstract

Poly(hydroxyalkanoate)s (PHAs) are biodegradable, thermoplastic bacterial biopolyesters, properties that make them promising candidates for sustainable textile fibers. However, PHAs face barriers to fiber production: brittleness, low melt strength, and pronounced thermal sensitivity within a narrow processing window (1–3). Blending is a well-established strategy for overcoming the limitations of individual polymers by combining the complementary properties of each component (4-6), and it has been increasingly applied to biopolymers such as PHB to improve their processability and mechanical performance (7).
This work addresses these limitations together through a systematic compounding series combining semi-crystalline (P3HB) with an amorphous P(3HB-co-4HB) copolymer, a talc-based nucleant masterbatch, and a poly (vinyl acetate)-based processing modifier, produced on a twin-screw extruder. The formulation strategy targets improved ductility, enhanced melt strength, and a widened thermal processing window. Compounds were characterized by melt rheology and DSC to resolve the interplay between nucleation-driven crystallization and modifier-driven melt behavior; FTIR analysis is ongoing. Selected compounds are subsequently processed in melt-spinning trials, and the resulting fibers are assessed by scanning electron microscopy (SEM) and tensile testing to link compound design to fiber morphology and mechanical performance.

The poster presents preliminary fiber-spinning and characterization results relevant to the design of fiber-grade biodegradable PHA compounds.
References
1. Sharma R, Ray AR (1995) Polyhydroxybutyrate, Its Copolymers and Blends. Journal of Macromolecular Science, Part C: Polymer Reviews 35:327–359.
2. Koller M, Salerno A, Braunegg G (2013) Polyhydroxyalkanoates: Basics, Production and Applications of Microbial Biopolyesters. In: Kabasci S (ed) Bio-Based Plastics. John Wiley & Sons Ltd, Chichester, UK, pp 137–170.
3. Pollet E, Avérous L (2011) Production, Chemistry and Properties of Polyhydroxyalkanoates. In: Plackett D (ed) Biopolymers – New Materials for Sustainable Films and Coatings. Wiley, pp 65–86.
4. Paul, D. R. (2012) Polymer Blends Volume 1 (Vol. 1). Elsevier.
5. Heeres, H. J., van Maastrigt, F., & Picchioni, F. (2013) Polymeric Blends with Biopolymers. Handbook of Biopolymer-Based Materials: From Blends and Composites to Gels and Complex Networks, 143-172.

*Speaker
†Corresponding author: aybige.ozkan@zorlu.com

6. Fredi, G., & Dorigato, A. (2024) Compatibilization of biopolymer blends: A review. Advanced Industrial and Engineering Polymer Research, 7(4), 373-404.
7. Majka TM, Raftopoulos KN, Hebda E, (2024) PHB+aPHA Blends: From Polymer Bacterial Synthesis through Blend Preparation to Final Processing by Extrusion for Sustainable Materials Design. Materials 17:3105.

Keywords: biopolymer, polyhydroxybutyrate, compound, melt spinning