Relationship between microstructure and properties of thermoplastic starch-based materials

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Abstract

BCG (Bio-Circular-Green) economy model has been proposed to drive the Thai economy forward and to release Thailand from the middle-income country trap, based on sustainable development: environmental protection, economic growth, and social equity. Thailand is an agricultural country full of various types of economic crops, including cassava, which is not a staple food for Thai people, but mostly exported as animal feed. The conversion of cassava into thermoplastic materials is an alternative to enhance its value (Bio economy). The resulting thermoplastic starch (TPS) can be melted and recycled, causing a reduced amount of waste during processing (Circular economy). In addition, TPS at the end of life is susceptible to biodegradation and composting (Green economy). Nevertheless, TPS alone is difficult to be exploited owing to its high moisture and water sensitivity and poor mechanical properties. Blending with biodegradable polyesters, such as poly(lactic acid) (PLA) and poly(butylene adipate-*co*-terephthalate) (PBAT) is an approach to overcome the limitations of TPS, and meanwhile to reduce the cost and enhance the biodegradability of those biodegradable polyesters. However, the properties of the final blends are relevant to their compositions, which in turn microstructures. The relationship between microstructure and properties of some TPS-based blends and composites will be demonstrated in this presentation. The weight fraction of TPS to biodegradable polyesters and the addition of third components, e.g., natural fibers [1], clay [2], oligo(lactic acid)-*g*-starch [3], and chitosan [4,5], are found to affect the morphological characteristics and other properties of the obtained materials.

Keywords: Thermoplastic starch, poly(lactic acid), poly(butylene adipate-*co*-terephthalate), extrusion, morphology

References:

[1] Chotiprayon, P., Chaisawad, B., Yoksan, R. Thermoplastic cassava starch/poly(lactic acid) blend reinforced with coir fibres. International Journal of Biological Macromolecules 2020, 156, 960-968.
[2] Dang, K.M., Yoksan, R., Pollet, E., Avérous, L. Morphology and properties of thermoplastic starch blended with biodegradable polyester and filled with halloysite nanoclay. Carbohydrate Polymers 2020, 242, 116392.
[3] Noivoil, N., Yoksan, R. Oligo(lactic acid)-grafted starch: A compatibilizer for poly(lactic acid)/thermoplastic starch blend. International Journal of Biological Macromolecules 2020, 160, 506-517.
[4] Dang K.M., Yoksan R. Morphological characteristics and barrier properties of thermoplastic starch/chitosan blown film. Carbohydrate Polymers 2016, 150, 40-47.
[5] Dang K.M., Yoksan R. Development of thermoplastic starch blown film by incorporating plasticized chitosan. Carbohydrate Polymers 2015, 115(22), 575-581.