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The role of natural hybrid nanobentonite/nanocellulose in enhancing the water resistance properties of the biodegradable thermoplastic starch

Abstract

This study focuses on investigating the effect of hybrid nanofillers on the hydration characteristics and soil biodegradability of the thermoplastic corn starch (TPCS) hybrid nanofiller biocomposite (TPCS-HB) films. The data were benchmarked with that of the pure TPCS and TPCS single nanofiller biocomposite (TPCS-SB) as control films. The water absorption properties of TPCS, TPCS-SB, and TPCS-HB films were analyzed and fitted with the standard Guggenheim-Anderson-de Boer equation to study the water activity of the films. Besides, the water permeability test, water vapor permeability, and soil biodegradability of the films were also studied and correlated with the films' surface morphology. The results indicated that the TPCS-HB films possess excellent hydration resistance and comparable biodegradable rate with the TPCS-SB films. The optimal water resistance properties were achieved when the optimal ratio of nanobentonite/nanocellulose (4:1) was incorporated into the TPCS matrix. The outcomes of this study provide an innovative idea and new insights that, by using natural and hybrid nanofillers, the hydrophobicity of the TPCS films could be enhanced. TPCS-HB films show great potential to be developed into a fully green biodegradable TPCS biocomposite film, especially for single-use plastic applications.

Keywords

Bentonite; Bioplastic; Environmentally Friendly.; Nanocellulose; Thermoplastic Starch