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Effect of different starch contents on physical, morphological, mechanical, barrier, and biodegradation properties of tapioca starch and poly(butylene adipate-co-terephthalate) blend film

Abstract

Study on degradation behaviors of biodegradable poly(butylene adipate-co-terephthalate) (PBAT) blended with different compositions of thermoplastic starch (TPS) under soil burial and natural weathering environments is vital in order to predict the product service-life and planning for in situ biodegradation after product disposal. In this article, different compositions of TPS (0%, 20%, 40%, 50%, and 60%) were compounded with PBAT using single screw extruder. The samples were characterized for their tensile properties, fractured surface morphology, water barrier and surface hydrophorbicity properties in order to investigate the effect of starch fractions in PBAT blends. The degradation behavior under natural weathering and soil burial conditions was also determined during the 9 months duration by observing the change of physical appearance, weight loss, surface morphology, chemical structural, and tensile properties. The findings showed that the addition of TPS (20%, 40%, 50%, and 60%) had led to a reduction in tensile strength (41.47%, 60.53%, 63.43%, and 68.53%), and reduction in elongation at break (42.92%, 92.1%, 92.23%, and 93.22%, respectively) and water barrier properties. The findings also showed that there were distinct degradation behavior under both conditions. Upon exposure to natural weathering, photodegradation and Norrish type I & II occurred whereas under the soil burial condition, hydrolytic, and enzymatic degradation take places. Sample with the highest starch contents underwent the highest weight loss and reduction in tensile properties under both environments. The findings in this study are useful in order to investigate the feasibility of PBAT/Tapioca starch blends for biodegradable plastic film for various industrial applications especially in packaging and agricultural mulch.

Keywords

Enzymatic Degradation; PBAT; Photodegradation; Polymer Blend; Tapioca Starch