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Interfacial Adhesion and Properties Improvement of Polyethylene/Thermoplastic Starch Blend Compatibilized by Stearic Acid-Grafted-Starch

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Abstract : Polyethylene (PE) is one of the most petroleum-based thermoplastic materials used in many applications including packaging due to its cheap, light-weight, chemically inert and capable to be converted into various shapes and sizes of products. Although PE is a commercially potential material, its non-biodegradability caused environmental problems. At present, bio-based polymers become more interesting owing to its bio-degradability, non-toxicity, and renewability as well as being eco-friendly. Thermoplastic starch (TPS) is a bio-based and biodegradable plastic produced from the plasticization of starch under applying heat and shear force. In many researches, TPS was blended with petroleum-based polymers including PE in order to reduce the cost and the use of those polymers. However, the phase separation between hydrophobic PE and hydrophilic TPS limited the amount of TPS incorporated. The immiscibility of two different polarity polymers can be diminished by adding compatibilizer. PE-based compatibilizers, e.g. polyethylene-grafted-maleic anhydride, polyethylene-co-vinyl alcohol, etc. have been applied for the PE/TPS blend system in order to improve their miscibility. Until now, there is no report about the utilization of starch-based compatibilizer for PE/TPS blend system. The aims of the present research were therefore to synthesize a new starch-based compatibilizer, i.e. stearic acid-grafted starch (SA-g-starch) and to study the effect of SA-g-starch on chemical interaction, morphological properties, tensile properties and water vapor as well as oxygen barrier properties of the PE/TPS blend films. PE/TPS blends without and with incorporating SA-g-starch with a content of 1, 3 and 5 part(s) per hundred parts of starch (phr) were prepared using a twin screw extruder and then blown into films using a film blowing machine. Incorporating 1 phr and 3 phr of SA-g-starch could improve miscibility of the two polymers as confirmed from the reduction of TPS phase size and the good dispersion of TPS phase in PE matrix. In addition, the blend containing SA-g-starch with contents of 1 phr and 3 phr exhibited higher tensile strength and extensibility, as well as lower water vapor and oxygen permeabilities than the naked blend. The above results suggested that SA-g-starch could be potentially applied as a compatibilizer for the PE/TPS blend system.

Keywords : blend, compatibilizer, polyethylene, thermoplastic starch
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