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ORIGINAL RESEARCH

Melt processing of ethylene–vinyl acetate/banana starch/Cloisite 20A organoclay nanocomposite films: structural, thermal and composting behavior

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Abstract
This work shows the preparation of ethylene vinyl acetate copolymer/banana starch/Cloisite **20A** organoclay (EVA/starch/C20A) nanocomposites by melt processing. Wide angle X-ray diffraction (WAXD), field emission scanning electron microscopy (FE-SEM), differential scanning calorimetry and thermogravimetric analysis were used to characterize the obtained nanocomposites. Mechanical properties were also determined. In addition, the performance of the nanocomposite films under composting was preliminarily studied; it was conducted using the soil burial test method. Despite knowing that the starch is difficult to process by extrusion, nanocomposite films with high homogeneity were obtained. In this case, C20A organoclay acts as an effective surfactant to make the starch natural polymer compatible with the EVA synthetic polymer. The good compatibility between EVA, starch and C20A clay was also deduced by the formation of intercalated and intercalated-exfoliated structures determined by WAXD and FE-SEM. Physical evidence of the damage in EVA/starch/C20A nanocomposite films after the composting test was observed. It is worth noting that despite the absence of starch, the EVA/C20A nanocomposite film, used as a control, also showed surface damage. This behavior is related to the organic modifier linked to clay C20A, which contains molecules derived from fatty acids that can be used as a food source for microorganisms.

Keywords Nanocomposites · Ethylene vinyl acetate · Banana starch · Organoclay · Composting

Introduction

Ethylene–vinyl acetate (EVA) is a versatile thermoplastic copolymer, whose properties and uses depend on the proportion of vinyl acetate in the copolymer. With this polymer, materials with rigid or elastic characteristics can be produced. The polar behavior of vinyl acetate groups in EVA can promote molecular interactions with other molecules, thereby obtaining a compatible system with synergistic properties. EVA copolymers have been blended with many other synthetic polymers to obtain materials with characteristics that can be used in various applications [1–3]. EVA has also been combined with inorganic components to obtain composites with improved specific properties such as flame retardancy [4, 5], thermal conductivity [6] or magnetic properties [7–9]. Layered silicates (such as montmorillonite) have been combined with EVA copolymers by melt processing to obtain nanocomposites. The mechanical, thermal, gas barrier and flame retardant properties [10–12] in EVA/clay systems have been improved with montmorillonite clay. It also improves pervaporation performance [13] and biostability behavior [14]. The improvement of the properties in a layered nanocomposite depends on the nanodispersion of the clay layers in the polymer matrix. EVA has also functioned as a compatibilizing polymer in

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