Pectin-organophilized ZnO nanoparticles as sustainable fillers for high-density polyethylene composites.

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Rok wydania

2021

Czasopismo

International Journal of Biological Macromolecules

Numer woluminu

182

Strony

1832-1842

DOI

10.1016/j.ijbiomac.2021.05.133

Kolekcja

Naukowa

Język

Angielski

Typ publikacji

Artykuł

Streszczenie

A series of nanocomposites made of high-density polyethylene (HDPE) and 10 wt% zinc oxide nanoparticles (ZnO NPs) were produced by extrusion and injection molding. The nanoparticles were prepared via a green way using the pectin-based banana peel extract as the stabilizer and a proper dispersion-providing agent. The fillers were well-dispersed in the matrix and the composites exhibited improved functional characteristics such as increased thermal stability and mechanical properties. The presence of the pectin-organophilized filler had a significant impact on the crystallization process of HDPE. The kinetics of the degradation process was also altered in comparison to the pure polymer. The fire properties of the composites were enhanced as the amount of the gas products produced during their degradation was reduced, what was confirmed by thermogravimetric analysis coupled with gas products analyses (TGA/FTIR/QMS). The structure and morphology of the materials were characterized by scanning electron microscope (SEM), infrared spectroscopy (FTIR), X-ray diffraction (XRD), and differential scanning calorimetry (DSC). Additionally, the mechanical properties were tested by tensile tests. An in-depth analysis revealed that the HDPE-pectin-ZnO interactions are crucial for the structural and performance properties of the final composite. The used biopolymer reacts with ZnO via ionic interaction and through hydrogen bond in the case of HDPE.

Słowa kluczowe

pectin, zinc oxide nanoparticles, polyethylene nanocomposities

Adres publiczny

http://dx.doi.org/10.1016/j.ijbiomac.2021.05.133

Strona internetowa wydawcy

http://www.elsevier.com