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MORPHOLOGICAL AND CRYSTALLINE STUDIES OF PHBV NANOCOMPOSITES FILLED WITH DIFFERENT TYPES OF NANOPARTICLES

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Morphological and crystalline studies of poly(hydroxybutyrate-co-hydroxyvalerate) PHBV nanocomposites were investigated using transmission electron microscopy (TEM), X-ray diffraction (XRD), small-angle X-ray scattering (SAXS), and differential scanning calorimetry (DSC). In this work, two different types of nanoparticles, a layered silicate - organically modified montmorillonite (OMMT) Cloisite 30B, and a tubular like clay - unmodified halloysite (HNT) were incorporated in the PHBV matrix. The nanocomposites with 1, 3 and 5 wt% of nanoparticles were obtained by melt processing in a twin screw extruder using two different processing conditions (low and high shear intensity). From TEM images and XRD results, it was possible to observe that the number of aggregates increased with the nanoparticle concentration. Furthermore, the nanocomposites prepared in high shear conditions presented a better distribution of nanoparticles in the PHBV matrix. In these cases, the morphological structures were a combination of few tactoids and partially exfoliated structure. The values of the lamellar long period, measured by SAXS, were similar for both systems. However, when processed with high shear intensity and higher amounts of nanoparticles, the results evidenced the formation of a second ordered structure, as shown by the change in the scattering peaks, mainly in the case of the PHBV/OMMT nanocomposites. The crystallization behavior, analyzed by DSC, indicated a lower nucleation density and lower crystallinity with the addition of both nanoparticles. Furthermore, the presence of OMMT platelets led to the formation of double melting peaks, which can be related to the formation of crystalline phases having different sizes and/or ordering. It can be concluded that the type and amount of nanoparticles affected the crystallization behavior of the PHBV nanocomposites. However, this was apparently independent on the processing conditions.