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Static and dynamic compressive properties of polypropylene/zinc oxide nanocomposites

Abstract

The effect of strain rate is widely recognized as an essential factor that influences the mechanical properties of polymer matrix composites. Despite its importance, no previous work has been reported on the high-strain rate behavior of polypropylene/zinc oxide nanocomposites. Based on this, static and dynamic compression properties of polypropylene/zinc oxide nanocomposites, with particle contents of 1%, 3%, and 5% by weight, were successfully studied at different strain rates (i.e., 0.01 s-1, 0.1 s-1, 650 s-1, 900 s-1, and 1100 s-1) using a universal testing machine and a split Hopkinson pressure bar apparatus. For standardization, approximately 24 nm of zinc oxide nanoparticles were embedded into polypropylene matrix for each of the tested polypropylene/zinc oxide nanocomposites. Results show that the yield strength, the ultimate strength, and the stiffness properties, of polypropylene/zinc oxide nanocomposites, were greatly affected by both particle loading and applied strain rate. Furthermore, the rate sensitivity and the absorbed energy of all tested specimens showed a positive increment with increasing strain rate, whereas the thermal activation volume showed a contrary trend. In addition, the fractographic analysis and particle dispersion of all composite specimens were successfully obtained using a field emisission scanning electron microscopy.

Keywords — Dynamic compressive properties, mechanical properties of polymers, polypropylene matrices, zinc oxide nanoparticles