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Processing strategies in bionanocomposites

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Abstract

In recent years, the development of environmentally friendly polymeric materials, which are primarily based on biodegradable polymers (from both fossil-fuel and natural resources) with balanced properties, has become the focus of considerable research attention. The use of nano-reinforcements in environmentally benign polymers has exhibited considerable promise for designing green polymeric materials with desired properties. A fairly new type of composite has emerged in which the reinforcing filler has nanometer scale dimensions (at least one dimension within the range of 1–100 nm). These nano-fillers include clays, carbon nanotubes, silver, titanium oxide, silica, nanocalcium carbonate, hydroxyapatite, and nanocellulose crystals. Such composite materials are known as bionanocomposites. Recently, a number of studies have examined the processing procedures for such nanocomposite materials because the processing techniques significantly affect the level of property changes expected in the nanocomposites when compared to the neat polymers or polymer blends. This paper critically reviews the most important methods used in the processing of bionanocomposites, which are based on most extensively used biodegradable polymer matrices and nano-fillers, with specific attention on the melt processing techniques. The correlation between the processing procedures and the resulting nanocomposite structures has been elucidated. Of the various types of nano-fillers, particular attention has been focused on clays and carbon nanotubes because of their widespread use in the bionanocomposite field.