Supercritical Carbon Dioxide as an Exfoliating Agent in the Preparation of a Layered Silicate Polymer Nanocomposite

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Supercritical CO2 has been strongly involved in the developments of foaming thermoplastics for the past two decades. It was observed in the course of foaming polymer nanocomposites that the addition of this supercritical solvent to the compounding process resulted in higher exfoliation for the dispersed clay mineral. There are now research efforts underway to utilize supercritical CO2 (scCO2) as an exfoliating aid without necessarily producing a foam. At issue with this new use for scCO2 is the nature by which it contributes to the more highly exfoliated morphology. The present work examines the influence of the supercritical solvent in the production of a highly exfoliated TPO nanocomposite. Using a high pressure batch system, mixtures of the compatibilizers and clays with TPO were examined in the presence of either CO2 or nitrogen for various conditions. The clay structure of the resulting nanocomposites was analyzed using X-ray diffraction (XRD) and transmission electron microscopy (TEM). Chemical interactions were characterized using solid-state nuclear magnetic resonance (13C NMR) and infrared spectroscopy as well as thermogravimetric analysis (TGA). Evidence pointed to the need to control the plasticizing aspects of scCO2 to allow for greater intercalation and exfoliation. Some of the data suggests that the supercritical solvent improved the associations of maleic anhydride with the clay surface. Overall, the data points to supercritical CO2 as an aid to improving interfacial interactions in a nanocomposite during preparation.
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