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Improving the mechanical and thermal properties of chlorinated poly(vinyl chloride) by incorporating modified $CaCO_3$ nanoparticles as a filler

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Abstract: Chlorinated poly(vinyl chloride) (CPVC)/calcium carbonate nanocomposites were successfully prepared by the incorporation of calcium carbonate ($CaCO_3$) nanoparticles into the CPVC matrix. The compatibility between the two phases was obtained by surface modification of the $CaCO_3$ nanoparticles with stearic acid, leading to improved material performance. The effects of the addition of different amounts of $CaCO_3$ nanoparticles to the CPVC on the thermal, mechanical, and morphological characteristics of the CPVC/$CaCO_3$ nanocomposites were investigated. The thermal stability of the CPVC/$CaCO_3$ nanocomposites was evaluated by thermogravimetric analysis and differential scanning calorimetry. In addition, the surface texture of the CPVC and the dispersion of the $CaCO_3$ were evaluated using scanning electron microscopy. Important enhancements in the thermal and mechanical properties of the modified CPVC/$CaCO_3$ nanocomposites were obtained by incorporating different amounts (2.00%, 3.75%, and 5.75%) of surface-modified $CaCO_3$ nanoparticles within the CPVC polymer matrix. The results reveal that 3.75% of $CaCO_3$ was the optimum amount, where the CPVC/$CaCO_3$ nanocomposite shows the highest impact strength, the highest tensile strength, the highest thermal stability, and the lowest elongation percentage. Replacement of the commercial impact modifier used in industry with the prepared surface-modified $CaCO_3$ nanoparticles for the development of CPVC was successfully achieved.

Key words: Chlorinated poly(vinyl chloride), $CaCO_3$ nanoparticles, nanocomposites, mechanical properties, thermal properties

1. Introduction

Polymer nanocomposites are considered a hot research area due to their extraordinary properties and distinctive design feasibility over pristine polymers. The properties of polymer-based nanocomposites depend upon many parameters such as the shape, chemical and physical characteristics, and the amount of constituent (filler) and interfacial interactions between the two phases [1–3]. Nanocomposites often exhibit properties that are significantly different from those of traditional composites in which a micrometer level inorganic component is

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