

EXFOLIATION OF MODIFIED MONTMORILLONITE NANOCCLAYS IN POLYSTYRENE WITH
SUPERCRITICAL CARBON DIOXIDE ASSISTED PROCESSING

By

Ryan Timothy Schneider

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Approved:

Rahmi Ozisik
Thesis Advisor

Richard Siegel
Thesis Advisor

Rensselaer Polytechnic Institute
Troy, New York

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Abstract

An experimental study was carried out to successfully exfoliate and disperse four different modified montmorillonite (MMT) clays in polystyrene using an environmentally benign process with supercritical carbon dioxide (scCO₂) as the processing aid. After being presoaked for 24 hours in a pressure chamber and rapidly injected into a twin screw bench-top extruder, the clays were dispersed into polystyrene. The clay that showed the greatest degree of exfoliation after scCO₂ treatment was Cloisite 93A due to its acidic hydrogen on the surfactant. This clay was previously theorized to be CO₂-philic due to its acidic hydrogen and this was verified in the current study. Cloisite 10A and 25A showed some degree of intercalation when melt-mixed with polystyrene probably due to the increased miscibility with non-polar polystyrene and the interaction with the benzyl ring in the 10A and 2-ethylhexyl modification in the 25A. There was little effect of scCO₂ treatment on these two clays. Cloisite 20A showed some degree of exfoliation when treated with scCO₂, however not nearly to the same degree as Cloisite 93A. Due to the degree of exfoliation of the Cloisite 93A in the polystyrene, flame retardant tests were performed on a pyrolysis-combustion flow calorimeter (PCFC) since clay nanocomposites have previously shown improved flame retardant qualities. Heat release capacities of the composites contained significant error and, as a result, were unable to provide conclusive evidence of an improvement in flame retardancy.