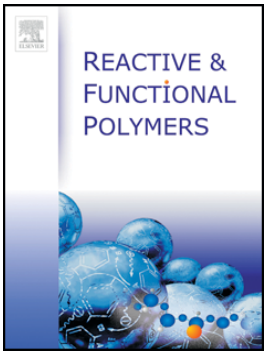

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Bio-based High Performance Epoxy-Anhydride Thermosets for Structural Composites: The Effect of Composition Variables

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Abstract

The structure-property relationships of a designed series of anhydride-cured epoxidized sucrose soyate (ESS) thermosets were studied. Epoxidized sucrose soyate is a novel bio-based epoxy resin derived from sucrose and soybean oil fatty acids, and it contains an average of 12 epoxy functional groups per molecule. This epoxy resin was crosslinked with methyl hexahydrophthalic anhydride to form polyester thermosets with high crosslink density, and a zinc-complex catalyst was used. In this study, the impact of composition variables—anhydride-to-epoxy molar ratio and catalyst amount—on the chemical, mechanical, and thermal properties of the thermosets were examined. All of the thermoset samples had very high gel fraction, which indicated excellent network connectivity. Samples made using an equimolar ratio of anhydride-to-epoxy groups had lower conversion of functional groups as shown by the somewhat lower gel fraction and higher moisture absorption. Analysis of the thermomechanical and tensile properties of the thermosets suggests that there is a factor interaction between anhydride-to-epoxy molar ratio and catalyst amount. Furthermore, the results suggest that the molecular networks of the thermoset samples are fairly complex due to the simultaneous competing reactions between catalyst-initiated epoxy-anhydride, hydroxyl- initiated epoxy-anhydride, and epoxy homopolymerization.

Keywords: epoxidized sucrose soyate, anhydride-cured epoxy, structure-property relationships, bio-based thermoset

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