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High performance, high bio-content thermosets for composites and coatings

While vegetable oils and other bio-based raw materials have been used in coatings resins for decades, new concepts are needed to transform bio-based raw materials into coatings resins that meet today's demanding performance needs. Highly crosslinked petrochem.-based thermosets are used in broad applications due to their high performance properties. Designing bio-based resins having a high no. of appropriately distributed functional groups per mol. can lead to thermosets having exceptional performance properties. Sucrose ester resins from vegetable oils, such as soybean oil, having a high degree of substitution can be epoxidized to yield biobased epoxy resins (e.g. Epoxidized sucrose soyate, ESS) having a high degree of functionality. These epoxy resins can then be crosslinked using several different mechanisms such as via anhydride-epoxy reactions, catalytic polymerization, and so on to yield coatings having high crosslink d., good hardness, excellent solvent resistance and adhesion. In addition, polyols can be derived from the epoxidized sucrose soyate resins via reaction with alcohols such as methanol to yield methoxy sucrose soyate polyol (MSSP). These highly functional polyols can be crosslinked using melamine-formaldehyde resins or polyisocyanates to yield thermoset coatings having performance properties comparable to their petrochemical counterparts and exceeding the performance of traditional vegetable oil based polyols.

Biography

Dean C Webster is Professor and Chair in the Department of Coatings and Polymeric Materials at North Dakota State University (NDSU). He received a BS in Chemistry and a PhD in Materials Engineering Science both from Virginia Tech. Prior to joining NDSU in 2001 he worked for Sherwin-Williams and at Eastman Chemical Company. He is the recipient of the 2011 Roy W Tess Award in Coatings Science given by the American Chemical Society, the 2013 Joesph Mattiello Lecture award given by the American Coatings Association, and the Waldron Research Award given by the NDSU Alumni Association. His research is in the area of new high performance polymer systems for coatings and composites, nanocomposites, polymers for marine antifouling coatings, and use of renewable resources in polymers and coatings systems.

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