

Professor Mannari receives Michigan Green Chemistry Governor's Award for 2012

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Sustainable and Advanced Coatings Materials Based on Soybean Oil

There has been considerable interest and efforts in developing bio-based platform materials that can replace fast-depleting petroleum based resources for meeting the needs of advanced materials while reducing their environmental footprint. Dr. Mannari's research group at Eastern Michigan University has developed low-cost, soybean oil-based, functional derivatives – Functional Soy Building Blocks (FSBB), as platform materials for making a range of oligomers and polymers for applications in environmentally preferable, advanced coatings. The FSBBs have been derived from commercially available commodity soy-products – epoxidized soybean oil and its downstream products.

The manufacturing process is a single-step, solvent-free, low energy input process with no by-product formation. The acid catalyst used is consumed during the reaction, and it uses conventional equipment and control systems. Leveraging unique chemical structure, morphology, and reactivity of FSBBs, and using molecular design and principles of green chemistry and engineering, they have developed a range of value-added oligomers and polymers that can replace conventional petro-based components currently used in advanced coating formulations. Thus, it is believed that the overall life-cycle impact of products based on these FSBBs will be much lower than petro-based products and substantially lower than other soy-based commercial products.

Current conventional UV-cure coating formulations use acrylic functional oligomers dissolved in low molecular weight monomeric acrylates, called reactive diluents. These reactive diluents, besides presenting some technical issues, are hazardous, toxic, and a source of dermatitis and respiratory issues for the users. These problems are well recognized and there is an acute need for safer alternatives. Acrylated soy-derivatives developed by Dr. Mannari are aimed to effectively address these problems. Due to their low viscosity (due to hyper-branched design) combined with high acrylate functionality; they are capable of completely eliminating reactive diluents, thereby making UV-cure compositions significantly safer.

The above mentioned soy building blocks have been used to successfully develop advanced coating materials, including water-borne, high-solids, and UV-curable, and have demonstrated sustainability benefits. Besides environmental benefits, lower cost, and high bio-based content, the unique benefits of this technology are the use of soybean oil – a major Michigan crop – and the design of materials and processes that ensure a low barrier for commercialization that will help Michigan manufacturing industries in a faster time-to-market.

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