Agreement Number: AL-C-2005-01
Partner Name: Archer Daniels Midland
Title: Preparation and Characterization of Paints and Coatings from Soy and Corn Oils
Principal Investigator: Richard C. Larock

Results:

This project was highly successful. A series of new waterborne polyurethane (PU)/acrylic hybrid latexes were successfully synthesized by the emulsion polymerization of acrylic monomers (butyl acrylate and methyl methacrylate) in the presence of a soybean oil-based waterborne PU dispersion using potassium persulfate as an initiator. The waterborne PU dispersion was synthesized by a polyaddition reaction of toluene 2,4-diisocyanate and a soybean oil-based polyol (SOL). The resulting hybrid latexes, containing 15-60 wt % SOL as a renewable resource, are very stable and exhibit uniform particle sizes of ~125 nm as determined by transmittance electronic microscopy. The structure, thermal, and mechanical properties of the resulting hybrid latex films have been investigated by Fourier transform infrared spectroscopy, solid state ^{13}C NMR spectroscopy, dynamic mechanical analysis, extraction, and mechanical testing. Grafting copolymerization of the acrylic monomers onto the PU network occurs during the emulsion polymerization, leading to a significant increase in the thermal and mechanical properties of the resulting hybrid latexes. This work provides a new way of utilizing renewable resources to prepare environmentally friendly hybrid latexes with high performance for coating applications.

In addition, a novel soybean oil-based vinyl-containing waterborne polyurethane (VPU) dispersion has been successfully synthesized from toluene 2,4-diisocyanate, dimethylol propionic acid and a 90:10 mixture of chlorinated soybean

oil-based polyol and acrylated epoxidized soybean oil (AESO). Then, a series of VPU/acrylic grafted latexes were prepared by emulsion graft copolymerization of acrylic monomers (40 wt % butyl acrylate and 60 wt % methyl methacrylate) in the presence of the VPU dispersion using potassium persulfate as an initiator. The structure, morphology, and thermal and mechanical properties of the resulting latexes, containing 15-60 wt % soybean oil-based polyols as a renewable resource, were investigated by Fourier transform infrared spectroscopy, solid state ^{13}C NMR spectroscopy, transmission electron microscopy, thermogravimetric analysis, dynamic mechanical analysis and mechanical testing. The results indicated that graft copolymerization of the acrylic monomers onto the VPU network occurs during emulsion polymerization, leading to a significant increase in the thermal stability and mechanical properties of the resulting miscible grafted latexes. This work provides new environmentally-friendly latexes from a renewable resource with high performance for coating applications.