Public Abstract
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Title:Polyurethane Foams from Novel Soy-based Polyols

Polyurethane foams and molded plastic films were prepared by reacting isocyanates with polyols containing 50% of vegetable oil-based polyols and 50% of petroleum-based polyols. The vegetable oil-based polyols included epoxidized soybean oil, epoxidized soybean oil reacted with acetol, commercial soybean oil polyols (soyols), polyols derived from epoxidized soybean oil and diglycerides, etc. The petroleum-based polyols were VoranolÂ® 490 for rigid foams and VoranolÂ® 4701 for flexible foams in the B-side of foam formulation. For rigid water-blown polyurethane foams, density, compressive strength and thermal conductivity were measured. For flexible water-blown polyurethane foams, density, 50% compression force deflection, 50% constant force deflection, and resilience of foams were determined. A dynamic mechanical spectrometer (DMS) and a differential scanning calorimeter (DSC) were used to characterize the hard segment (HS) and soft segment (SS) ratio and thermal properties of plastic. Various functional groups in both flexible polyurethane foam and plastic film were characterized using Fourier transform-infrared spectroscopy with attenuated total reflectance (FTIR-ATR).

Most foams made with polyols containing 50% of vegetable oil-based polyols were inferior to foams made from 100% petroleum-based polyol. However, rigid foams made with polyols containing 50% hydroxy soybean oil, epoxidized soybean oil reacted with acetol, and oxidized epoxidized diglyceride of soybean oil not only had superior thermal conductivity, but also better density and compressive strength properties than foams made from 100% petroleum polyol. Although the epoxidized soybean oil did not have any hydroxyl functional group to react with isocyanate, it showed interesting properties when used to replace the petroleum-based polyols in the B-side of foam formulation. For rigid polyurethane foams, no significant changes in density, compressive strength decreased and thermal conductivity decreased first and then increased with increasing epoxidized soybean oil. Similar to compressive strength, the foaming temperature decreased with decreasing isocyanate index and increasing ESBO replacement. Due to the lower reactivity of ESBO with isocyanate, the rate of foaming temperature decrease with decreasing isocyanate index was in the order of 0%>20%>50% ESBO replacement. For flexible polyurethane foams, when increasing epoxidized soybean oil, foam density decreased first and then increased, no changes in 50% compression force deflection first and then increased, increasing 50% constant force deflection, and decreasing resilience. When increasing the ESBO content, the peak of tanÎ´ in DMS analysis and âˆ†cp in DSC analysis of plastic films both decreased indicating the hard segment increased and the soft segment decreased in plastic film, respectively. The FTIR-ATR results also show the hydrogen-bonded urethane group increased in plastic films with increasing ESBO content.