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Bio-based Polymer Foam from Soyoil LAETITIA M. BONNAILLIE, RICHARD P. WOOL, Dept Chemical Engineering, University of Delaware — The growing bio-based polymeric foam industry is presently lead by plant oil-based polyols for polyurethanes and starch foams. We developed a new resilient, thermosetting foam system with a bio-based content higher than 80%. The acrylated epoxidized soybean oil and its fatty acid monomers is foamed with pressurized carbon dioxide and cured with free-radical initiators. The foam structure and pore dynamics are highly dependent on the temperature, viscosity and extent of reaction. Low-temperature cure hinds the destructive pore coalescence and the application of a controlled vacuum results in foams with lower densities $\sim$ 0.1 g/cc, but larger cells. We analyze the physics of foam formation and stability, as well as the structure and mechanical properties of the cured foam using rigidity percolation theory. The parameters studied include temperature, vacuum applied, and cross-link density. Additives bring additional improvements: nucleating agents and surfactants help produce foams with a high concentration of small cells and low bulk density. Hard and soft thermosetting foams with a bio content superior to 80% are successfully produced and tested. Potential applications include foam-core composites for hurricane-resistant housing, structural reinforcement for windmill blades, and tissue scaffolds.

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