

N°427 / OC

TOPIC(s) : Polymers

Silicone structurants for soybean oil: foams, elastomers, and candles

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PURPOSE OF THE ABSTRACT

Soybean oil is a commercial, high volume, unsaturated triglyceride predominantly used for cooking applications. However, it also has a long history in polymeric materials in the form of soybean oil-derived polyurethanes. While these polyurethanes are considered to be greener than those derived from petroleum feedstocks they still possess a problematic combustion profile, as concerns exist about the nitrogen-containing compounds derived from the urethane linkage that are found in the smoke[1],[2]. Silicone materials have been shown to have a cleaner combustion profile but suffer from high costs [3],[4]. We were curious to explore the possibility of imparting the beneficial combustion properties exhibited by silicones onto soybean oil through the synthesis of soybean oil-silicone elastomers and foams.

Soybean oil was modified via an ene reaction to incorporate alkoxy silane functionality that was used in a subsequent Piers-Rubinsztajn reaction with silicones to create foams and elastomers (Scheme A) [5]. Crosslinked materials with densities ranging from ~0.6-0.9 g/mL and containing up to 76% by weight soybean oil were prepared [6]. The addition of varying amounts of a linear PDMS chain extender allowed for control of the modulus (0.04-0.32 MPa). Crosslinking rapidly occurred; < 60 s was typically required for full cure. Dense foams were produced without the need for external blowing agents, due to the generation of methane as a by-product of the Piers-Rubinsztajn reaction. The soybean oil/silicone materials burned cleanly and without dripping, as shown in particular with the elastomer containing 76wt% soybean oil.

FIGURES

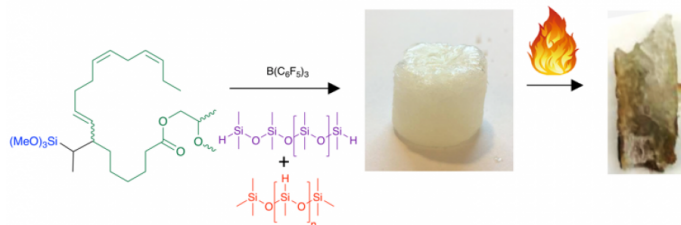


FIGURE 1

Scheme A

Reaction of silylated soybean oil via the PR reaction to produce elastomeric foams.

FIGURE 2

KEYWORDS

soybean oil | Piers-Rubinsztajn | flammability | foams

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