

Characterization of novel rigid-foam polyurethanes from residual palm oil and algae oil

ABSTRACT

The immense demand of plastics worldwide has created a substantial pollution problem that appears not to have an end. New governmental policies and customers preferences towards environmental friendly materials require continued research on biodegradable materials derived from biological resource. In this work, residual palm oil (RPO) recovered from palm oil mill waste effluent was mixed with algae oil (AO) to produce rigid foam polyurethanes (bio-RFPU) at different ratios (AO/RPO) 10/90, 20/80, 30/70, 40/60 and 50/50 by one pot epoxidation and ring opening followed by polymerization with Methylene diphenyl diisocyanate (MDI). Prior to polymerization, significant improvement of 49% was found in the hydroxyl number of the RPO(AO) polyol when AO content was increased from 10 to 50%. Similarly, the homogeneous structure of the cell and the thermal stability of the final bio-RFPU was increased in the samples with 50% AO. Different characterization techniques such as scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), dynamic mechanical analysis (DMA) and compression/flexural tests were conducted, and the results presented. The thermal degradation profile of the samples containing 40 and 50% of AO was found to be similar to RFPU with fire retardant and insulation properties. The compressive strength and the biodegradability of the bio-RFPU increased 60% when AO was increased between samples with 10 and 50% AO. Therefore, the developed bio-RFPU is expected to have great potential as core materials in industrial applications such as sandwich panels as well as in other insulation material.

Keyword: Recovered palm oil; Algae oil; Bio-based rigid foam; Thermal stability; Insulation; Biodegradation