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Polyurethanes obtained from Momonas (*Ricinus communis*) oil

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Abstract – A series of polyurethanes from polyols derived from Momonas (castor - *Ricinus communis*) oil were prepared, and their thermal stability in air and nitrogen assessed by thermogravimetric analysis. The IR spectroscopic analysis of the oil have also been performed. The resins are formed by the reaction of oil with 1,6-hexamethylene diisocyanate. The synthesized resins have been characterized by IR spectroscopic analysis, TGA analysis and ^{1}H RMN.

Recent years have witnessed an increasing interest in biomaterials derived from renewable resources. One major initiative has been the synthesis of a wide range of biopolymers from annually renewable and environmentally benign starting materials obtained from agricultural and animal sources []. These materials often possess thermal and mechanical properties comparable to or better than those of widely used industrial polymers. As such, they might replace petroleum-based polymers resulting in waste reduction and overall petroleum resource preservation. Vegetable oils are one of the cheapest and most abundant, annually renewable natural resources available in large quantities from various oilseeds. Vegetable oils are excellent renewable source of raw materials for the manufacture of polyurethane components such as polyols. The transformations of the double bonds of triglycerides of oils to hydroxyls and their application in polyurethanes have been the subject of many studies [2]. The main technological advantages of these polyurethanes from vegetable oils are high strength as well as stiffness, environmental resistance and long life. In the present study we report the preparation of A polymer using Castor Oil (mamona - *Ricinus communis*) with two different molar ratios of 1,6-hexamethylene diisocyanate (HMDI).

Various physical properties of the oil have been determined. The IR spectrum supports the presence of both saturated and unsaturated acids in the oil. ^{1}H NMR spectrum of the oil shows protons of terminal methyl group at δ = 0.85–0.90 ppm and –CH2– group attached next to the terminal ethyl group at δ = 1.60 ppm. The peaks at δ = 1.25–1.30 ppm for protons of all the internal –CH$_2$– groups present in the fatty acids chains. The –CH$_2$– protons of glycerol found at δ = 4.1–4.3 ppm and the protons for –CH– of glycerol and unsaturated carbons appear at δ = 5.33–5.35 ppm. From ^{1}H NMR spectra of the resins, it is confirmed the presence of the following peaks at δ = 0.85–0.89 ppm for terminal methyl group of the fatty acids chains, and δ = 1.59–1.60 ppm may be due to the protons of –CH$_2$– group attached next to the above terminal methyl group. The peaks at δ = 1.15–1.30 ppm for the protons of all the internal –CH$_2$– groups present in the fatty acids chains. The peaks for protons of unsaturated carbons appear at δ = 5.33–5.34 ppm. The –CH$_2$– protons of glycerol moiety found at δ = 3.59–4.79 ppm whereas the proton for –CH– of glycerol unit observed at very high value of δ = 6.32 ppm may be due to desheilding effect by the diiso. Dynamic TGA curves in nitrogen of all oil based polyurethanes are shown in Figure 1. Whereas, oil-based polyurethanes show two step degradation. Derivative TGA curves of the same polymers reveal actually two and three main degradation processes,The first step is associated with the first 10% of the weight loss, and the second with the remaining 90%. The shapes of the weight loss curves of all polyurethanes are almost identical, and overall differences in thermal stability appear to be small.

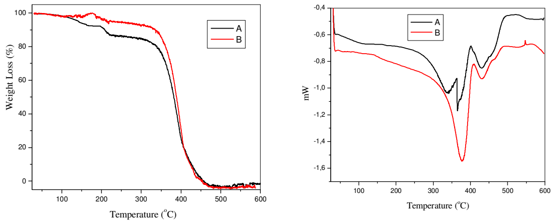

Figure 1: TGA and DSC curves in nitrogen of all polyurethanes obtained with: A) 0, 5 and B) 5,0 mL of 1,6-hexamethylene diisocyanate

The exothermic peak that appears in the crosslinked polymer samples, between 100 and 250 °C, should be mentioned. It may correspond to the oxidation reaction and the crosslinking process of the polymers. DSC traces, exhibit a single melting peak about 80°C for the reaction A, showed the main peak about 35 °C. The smaller peak could be attributed to the crystallites containing a higher content of saturated fatty acids.

References:

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