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Sweet Polymers: Synthesis and characterization of xylitol-based epoxidized linseed oil resins

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Abstract: Novel xylitol-functionalized epoxidized linseed oil (ELO) polyols were synthesized. Epoxidized linseed oil obtained by a chemoenzymatic method was first reacted with xylitol by a nucleophilic opening of the epoxy rings with one of the primary hydroxyl groups from xylitol, reaching a partial 50% (ELO-Xyl-50%) and a complete 100% (ELO-Xyl-100%) functionalization. Using N-methyl-2-pyrrolidone (NMP) as the solvent, the $ZnCl_2$ catalyst amount, time and temperature were studied to achieve these functionalizations. Fully bio-resourced polymers were obtained by thermal curing in which the ELO-Xyl-50% monomer was crosslinked by a reaction between epoxy residues (50%) and the primary hydroxyls of pendant xylitol at 180°C for 90 min, whereas the ELO-Xyl-100% monomer was mixed with ELO in stoichiometrically molar proportions and cured at 200°C for 120 min. All of the structures were characterized by ^{1}H NMR, FT-IR, DSC and TGA. The effect of the xylitol functionalization in monomers was evidenced by their viscosity, whereas for polymers, the dielectric constant was evaluated.

Keywords: *linseed oil, biopolymers, nucleophilic epoxide opening, xylitol, polyols.*

1. Introduction

The use of renewable raw materials for developing bio-based polymers and composites is becoming increasingly significant due to environmental concerns and the need to substitute fossil resources. Natural oils have been shown to be useful for the synthesis of polymers [1], and they are a potential alternative because they are natural, renewable and biodegradable compounds with low toxicity to the environment [2]. They are also abundant and inexpensive raw materials that can be easily accessed [3]. Natural oils have been used as starting materials for the production of coatings, paints, lubricants, soaps, and inks [4-7].

Specifically, linseed oil is an excellent option for the synthesis of polymeric materials because its chemical structure, which has a large number of unsaturations, could be chemically modified to introduce new functional groups that readily polymerize.