Área: MAT

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Preparation and Characterization of a composite from chitosan and a castor oil-Polyurethane

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Highlights

This work demonstrates the results from preparation and characterization of composites from polyurethane derivated from castor oil, methylene diphenyl diisocyanate (MDI) and chitosan (CTS). The obtained composite polymers (PUCTS) were characterized by FTIR, MEV and thermal analytical techniques (TG and DMA).

Abstract

Polyurethane is a class of polymers synthesized from the polyaddition reaction of a polyol (soft segments) with a diisocyanate (hard segments)[1]. Urethane polymers are widely used in industry due to the versatility of their physicochemical, mechanical and thermal properties. Most polyols used in synthesis are from fossil and non-renewable sources[2]. In recent years, vegetable oils and polysaccharides derived from plants and animals have emerged as low-cost sources and renewable materials in the preparation of polyurethanes[3]. Castor oil (CO) became attractive since it is made up of 90% ricinoleic acid, with three hydroxyl groups (OH) attached to carbon 12 of its fatty acids[4]. Chitosan (CTS) is a copolymer formed by monomeric units of 2-amino-2- deoxy-D-glucopyranose and 2-acetamido-2-deoxy-D-glucopyranose randomly, united by glycosidic β (1→4) bond. It is obtained from deacetylation reaction of chitin, alkaline hydrolysis[5]. CTS presents biocompatibility, biodegradability, mucoadhesiveness, antimicrobian activity, nontoxicity, ability of acting as transport matrix, among interesting properties[5]. Composites of polyurethanes and chitosan were prepared under different conditions by direct 'one-shot' method, in which chitosan was scattered into polyol, derived from CO. After that, it was mixed with methylene diphenyl diisocyanate (MDI) in a reaction flask at room temperature, under stirring. The mixture was degassed and poured into a silicone mold to cure at room temperature. Composites PUCTS were characterized by FTIR, SEM and thermoanalytical techniques (TG, DMA). Regarding to characterization all composites presented similar properties. Changes were observed on FTIR spectral of initial and final products: OH bands of polyol in the region of 3500-3200 cm^{-1} and N=C=O band from MDI at 2189 cm^{-1} were not observed, while it was observed the bands related to C=O and NH in the region of 1750 -1500 cm^{-1} due to the formation of the urethane bond. Moreover, the bands features CTS were also observed with the increase of percentage in composites. According to SEM images, the morphology of PU, in the different magnifications, showed roughness on the surface with circular spots inside, with diameters smaller than 200 μm, characteristic of the outflow of gases during polymerization. The presence of CTS in composites was observed due to the presence of smooth plaques randomly distributed in the PU. TG curves of PUCTS showed five steps of mass loss attributed to loss of water and/or volatile molecules; of urethane, ester of polyol and chitosan decompositions and burning of carbonized material, leaving a residue of about 0,5% at 1000°C. PUCTS samples were thermally stable up to approximately 200°C. DMA curves present the respective glass transition temperature for composites PUCTS in the range of 16-20°C. The results are relevant for the study of polyurethane obtained from renewable sources, considering possible applications in the compatible biological materials area.

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