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Degradation of PLA in a simulated marine environment after 600 days

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Introduction: One alternative for minimizing the problem of polymer accumulation in marine environment is the development of biodegradable polymers. Poly(lactic acid) (PLA) is a biodegradable thermoplastic, degraded by a hydrolysis reaction. Buriti is an abundant palm tree in Brazil, and has relevant applications as polymers reinforcement filler. In view of the above, the main goal of this work is the assessment of the influence of buriti fibers and coupling agent triacetin on the degradation of PLA composites for different exposure times in simulated marine environment.

Experimental: PLA and PLA with triacetin (5 wt%) and buriti fiber (30 wt%) designed as PLA/B/T were extruded in a single-screw extruder. The product was milled, dried and compression molded in a press for 60 seconds, at 180°C to prepare test specimens with dimensions 200 mm x 100 mm and 1 mm thickness. The simulated marine environment used is provided with 7 lamps (250 W) simulating ultraviolet rays. Withdrawal of samples was performed after 15, 30, 45, 60, 100 and 600 days of exposure. The morphological characterization of the sample surface was performed in a SEM. Analyses of chemical changes were monitored by FTIR, on prepared films by the KBr pellet method, in the wave number range of 4000 to 400 cm^{-1}. Lactic acid index (ILA) was calculated as the ratio between band surfaces A1 (3200 cm^{-1}) and A2 (750 cm^{-1}), which is considered a PLA band.

Results: After 600 days of exposure in a simulated marine environment, all the samples showed colonization by different kinds of diatoms (different frustules). In this study, the buriti fiber favored degradation.

Conclusions: PLA degradation in a marine environment is favored by the use of natural fibers, showing that the polymer can provide, when used as a composite, while in use, and lower post use durability which leads to environmental benefits.

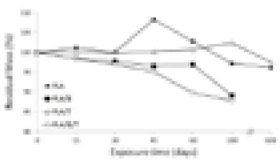

Figure 1: IAL monitored in the region of 3050 to 3700 cm-1. Lactic acid index (IAL) for PLA and for PLA/B, PLA/T and PLA/B/T composites versus different exposure times.

Figure 2: Simulated marine environment

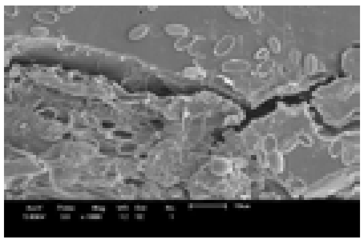

Figure 3: SEM micrographs after 600 days of exposure.

Biography

Diego Piazza has completed graduation at Tecnologia em Polimeros from Universidade de Caxias do Sul (2007), Master's at Engenharia e Ciencia dos Materiais from Universidade de Caxias do Sul (2011) and Doctorate at Engineering from Universidade Federal do Rio Grande do Sul (2016). He is currently a Professor at the University of Caxias do Sul and has held the position of Coordinator of the Polymer Technology Undergraduate Course at UCS from 2011 to 2016. He works in the field of polymer nanocomposites, coatings, materials recycling and the processing of polymeric materials by injection, extrusion, thermoforming and rotomoulding. He participates in the UCS Entrepreneurship program. He integrates the group of researchers with The Ocean Cleanup (Holland) in the study of degradation and recovery of polymers from the marine environment. He has experience in the area of project development and research in the field of materials science and engineering, with emphasis on polymers, polymer materials processing, polymer nanocomposites, organic coatings, intelligent inks, powder paints, and materials recycling.

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