



THERMOPLASTIC STARCH MODIFICATION BY REACTIVE EXTRUSION: NEW MATERIALS FROM STARCH BY DEPOLYMERIZATION AND POLYMERIZATION IN A SINGLE STEP PROCESSING

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Thermoplastic starch was modified by a single-step extrusion processing by depolymerization followed by polymerization reactions. Depolymerization was performed with citric acid (CA) and polymerization with 4,4'-methylenediphenyl diisocyanate (MDI). CA causes esterification (1) and extensive chain scission due to hydrolysis (2) which reduces dramatically starch molecular weight. The product, a mixture of citric acid, glycerol and low molar mass starch was polymerized with MDI to produce an hydroxylated polyurethane. The process was entirely conducted in a single step, which includes the destructure and plasticization of starch. The ensuing material shows a new structure since starch fragments and also glycerol moieties will be combined. The chemical modifications were performed in a single screw extruder specially designed for this purpose and the products were characterized by Fourier Transform Infrared Spectra (FTIR) X-Ray diffraction, water absorption tests, high-performance size exclusion chromatography (HPSEC) and mechanical tests. Polymerization reaction was followed by FTIR to confirm the formation of urethane linkages (absorption band at 1725 cm⁻¹) and the decrease in -OH band at 1650 cm⁻¹. The mechanical properties confirmed the occurrence of chain breaking and polymerization. The possibility of controlling the process by depolymerization and polymerization reactions allows a large range of TPS to be produced with tunable physical and chemical properties opening new possibilities for TPS and its blends. This work was supported by the State of São Paulo Research Foundation (FAPESP).

References:

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