
Durability of bio-based polyesters : effet of stereocomplexation of PLA mixtures

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Résumé

PLA is a biopolymer known to be difficult to recycle and which undergoes thermal degradation when it is melted.

In this work, different grades of PLA including D120 (PDLA) and L175 (PLLA) and the mixture PLLA/PDLA (50/50) were injected in the form of Iso 527-2 test pieces.

These materials were exposed to a hydrothermal aging process in a dishwasher in order to evaluate their durability with a view to reusing or recycling these materials.

The surface morphology of the treated materials was evaluated by microscopic analyzes while the thermal stability and crystallinity of the materials by DSC. Mechanical analyzes in particular the charpy shock supplemented by the measurement of molar weight by GPC complete the characterization of these materials.

At the other hand, potential degradation products or molecules released after the hydrothermal treatment were quantified by measuring total organic carbon (TOC) and identified by liquid chromatography coupled with mass spectroscopy (LC-MS).

Visual observation of aged materials shows us a whitening of the materials from the first washing cycle, accentuated with the washing cycles, while the traces and cracks observed under the microscope after 50 washing cycles for PDLA.

DSC thermal analyzes reveal the formation of the stereo-complex in the case of the PDLA/PLLA mixture, with a new crystal structure quite different from that of each homopolymer. The stereo-complex formed by the mixture would provide increased crystallinity to the materials. Variations in cold crystallization and melt temperatures as well as enthalpies of these materials after dishwasher treatment indicate chain scission-induced molecular reorganization with higher mobility, a consequence of the reduced molecular weight measured by GPC. Mechanical analyzes show that with washing cycles, materials lose their impact resistance. The energy required to achieve impact breakage decreases with wash cycles.

TOC measurement indicates a low concentration of potentially released products of approximately 0.18% and 0.07% for pdl and pll/pdl respectively. These released degradation

*Intervenant

by-products are mainly fatty and lactic acids.

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