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SEMINAR

Improvements in mechanical strength and thermal stability of injection and compression molded components in custom-built Poly Lactic Acids (PLAs)

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Abstract. Bottles and other packaging account for approximately 70% of the global market of biopolymers, which include both biodegradable and durable materials. Durable materials account for the vast majority of the market, especially the bottles. Degradable polymers are instead refrained by the often-insufficient mechanical and thermal properties, which limit their usage to single-use packaging items at ambient temperature and in dry conditions. In this respect, the present work deals with the injection and compression molding process of custom-built Poly Lactic Acids (PLAs), which are designed to be compostable, suitable for food contact and characterized by a good compromise of mechanical properties and thermal stability. A commercial grade PLA was, therefore, compounded in a twin-screw co-rotating extruder by the addition of maleated and glycidyl methacrylate PLAs as chain extenders and micro-lamellar talc as mineral filler and nucleation promoter. After pelletizing, the resulting compounds were melt-processed by injection and compression molding, thus producing flat components. Differential Scanning Calorimetry (DSC), Fourier Transform-Infrared Spectroscopy (FTIR), heat deflection and flexural tests in static machine and top-hat cylindrical flat indentations were performed to evaluate the thermal and mechanical response of the molded components. The experimental findings show that crystallization of the PLA can be controlled by fine-tuning the compound formulation as well as by the setting of the processing parameters. In addition, achievement of the appropriate crystallization degree in the polymer is found to lead to molded components, which exhibit improved mechanical strength and high thermal stability. Accordingly, the molded components feature the potential to expand significantly the fields of application of non-durable polymers, thus posing a valid alternative to both durable biopolymers and conventional plastics.