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Manufacturing and Characterization of Bioresorbable Self-Reinforced PLA Composites for Bone Applications

Authors : Carolina Pereira Lobato Costa, Cristina Pascual-González, Monica Echeverry, Javier LLorca, Carlos Gonzáléz, Juan Pedro Fernández-Bláquez

Abstract : Although the potential of PLA self-reinforced composites for bone applications, not much literature addresses optimal manufacturing conditions. In this regard, this paper describes the woven self-reinforced PLA composites manufacturing processes: the commingling of yarns, weaving, and hot pressing and characterizes the manufactured laminates. Different structures and properties can be achieved by varying the hot compaction process parameters (pressure, holding time, and temperature). The specimens manufactured were characterized in terms of thermal properties (DSC), microstructure (C-scan optical microscope and SEM), strength (tensile test), and biocompatibility (MTT assays). Considering the final device, 155 ℃ for 10 min at 2 MPa act as the more appropriate hot pressing parameters. The laminate produced with these conditions has few voids/porosity, a tensile strength of 30.39 ± 1.21 MPa, and a modulus of 4.09 ± 0.24 GPa. Subsequently to the tensile testing was possible to observe fiber pullout from the fracture surfaces, confirming that this material behaves as a composite. From the results, no single laminate can fulfill all the requirements, being necessary to compromise in function of the priority property. Further investigation is required to improve materials' mechanical performance. Subsequently, process parameters and materials configuration can be adjusted depending on the place and type of implant to suit its function.

Keywords : woven fabric, self-reinforced polymer composite, poly(lactic acid), biodegradable
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