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Research paper

Mechanical study of PLA–PCL fibers during in vitro degradation

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ABSTRACT

The aliphatic polyesters are widely used in biomedical applications since they are susceptible to hydrolytic and/or enzymatic chain cleavage, leading to α -hydroxyacids, generally metabolized in the human body. This is particularly useful for many biomedical applications, especially, for temporary mechanical supports in regenerative medical devices. Ideally, the degradation should be compatible with the tissue recovering.

In this work, the evolution of mechanical properties during degradation is discussed based on experimental data. The decrease of tensile strength of PLA–PCL fibers follows the same trend as the decrease of molecular weight, and so it can also be modeled using a first order equation. For each degradation stage, hyperelastic models such as Neo–Hookean, Mooney–Rivlin and second reduced order, allow a reasonable approximation of the material behavior. Based on this knowledge, constitutive models that describe the mechanical behavior during degradation are proposed and experimentally validated. The proposed theoretical models and methods may be adapted and used in other biodegradable materials, and can be considered fundamental tools in the design of regenerative medical devices where strain energy is an important requirement, such as, for example, ligaments, cartilage and stents.

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1. Introduction

PLA and PCL are two important members of the aliphatic polyesters class of biodegradable materials. For the purpose of an ongoing task, which consists on the dimensioning

of a ligament augmentation device (LAD), we are studying models to simulate the evolution of mechanical behavior with degradation, which is relevant in the design phase of this biodegradable device. Both these thermoplastics are hydrophilic with slow degradation rates, and for this reason

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