

Modelling of mechanical properties of a PLA-b-PEG-b-PLA biodegradable triblock copolymer during hydrolytic degradation.

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PLA-based biodegradable copolymers are used in many biomedical applications such as temporary implantable devices. Especially, PLA-b-PEG-b-PLA is an excellent candidate for tissue engineering applications. Indeed, it has a good biocompatibility and possesses both mechanical properties of PLA and hydrophilicity of PEG, allowing good properties and degradation time modulation. The main degradation process, for this type of polymers is the hydrolysis of ester links. After the diffusion of water into the polymer bulk, the hydrolysis reaction breaks the polymeric bonds. Modelling of mechanical properties evolution of biodegradable polymers is essential in order to design devices.

The aim of this study is to explore and model the viscoelastic properties evolution of a PLA-b-PEG-b-PLA biodegradable copolymer during hydrolytic degradation. The mass decrease, the number average molecular weight and the mechanical properties were studied during 7 degradation weeks. Tensile and relaxation tests in a liquid bath at 37°C were realized at different states of degradation. Stress relaxation is observed, highlighting a viscoelastic behavior for every degradation state. Moreover, the polymer suffers a loss of mechanical properties in the course of degradation. In order to model viscoelastic properties, a generalized Maxwell model is used. This model is first identified on results obtained for non degraded material. Then, based on the invariance of the normalized relaxation curves experimentally observed for the degraded materials, a degradation variable is introduced in the model. Predictions of the model are then compared to experimental results in the course of degradation. The abilities and limits of the model are discussed.