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Research paper

Effects of lactide monomer on the hydrolytic degradation of poly(lactide-co-glycolide) 85L/15G

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ABSTRACT

The hydrolytic degradation of oriented poly(*L*-lactide-co-glycolide) 85L/15G (PLGA 85/15) sample materials with various amounts of lactide monomer was monitored *in vitro* at 37 °C. The materials were manufactured from medical grade PLGA 85/15 by a two-step melt extrusion-die drawing process. Results showed that the hydrolytic degradation rate depended highly on the lactide monomer content, which in turn influenced the retention of mechanical properties, mass loss, crystallinity, and dimensional stability. Even small quantities of lactide monomer (0.05–0.20 wt%) affected especially the retention of mechanical properties, which started to decline rapidly upon the inherent viscosity reaching 0.6–0.8 dl/g due to hydrolytic degradation. Based on our hydrolytic degradation data, we constructed a simplified mathematical model of degradation-related strength retention and recommend it as a functional quality control tool for melt-processed biodegradable medical devices manufactured from poly(*L*-lactide-co-glycolide) 85L/15G.

1. Introduction

Used successfully since the 1980s (Rokkanen et al., 1985), polylactide and its copolymers are currently the most common bioabsorbable polymers for medical devices. They are hydrolytically degradable polymers with significant advantages over non-absorbable materials for medical devices, because they need not be surgically removed as their degradation products are absorbed by the human body (Rokkanen et al., 2000; Landes et al., 2006; Hollinger and Battistone, 1986).

Melt processing methods such as extrusion or injection molding are commonly used to process polymers in the manufacture of bioabsorbable medical devices. At their best, these processes enable production of well functioning medical devices (Rokkanen et al., 2000; Landes et al., 2006; Törmälä, 1992; Ashammakhi et al., 2004; Kellomäki et al., 2000; Tiainen et al., 2004) without harmful chemicals and allow addition of medically beneficial components such as osteoconductive ceramics (Kellomäki et al., 2000; Niiranen et al., 2004; Niemelä, 2005; Haaparanta et al., 2010) or antibiotics (Veiranto et al., 2002) in multifunctional medical materials. Despite today's high quality of medical grade polylactides as raw material, a limiting factor in melt processing is these polyesters' molecular degradation due to their thermal instability. During processing, factors such as melt temperature and polymer molecular weight affect their

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