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PII: S1751-6161(18)30044-4
DOI: https://doi.org/10.1016/j.jmbbm.2018.01.030
Reference: JMBBM2669

To appear in: *Journal of the Mechanical Behavior of Biomedical Materials*

Received date: 3 October 2017
Revised date: 25 January 2018
Accepted date: 28 January 2018

Modeling the effects of lipid contamination in Poly(Styrene-Isobutylene-Styrene) (SIBS)

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Abstract

Lipid uptake and subsequent degradation was characterized as a function of molecular weight and styrene content in four different formulations of poly(Styrene-block-Isobutylene-block-Styrene) (SIBS). Mechanical testing in uniaxial tension at varying lipid concentrations showed a consistent decrease in tensile strength for all specimens due to lipid contamination. Higher styrene content was associated with an improved resistance to lipid intrusion. A decrease in elongation at break was observed for low molecular weight formulations only; an expected result of the stiffer network and local chain motion restriction due to increased entanglements in high molecular weight SIBS. A new, coupled diffusion/finite element method was used to recover the swelling coefficient of the four different SIBS formulations. The Ogden strain-density energy function recovered from unidirectional tensile testing and diffusion properties from gravimetric analysis were used to construct the finite element model. The predicted swelling behavior matched experimental data and the swelling coefficients were recovered for all formulations tested. Results indicate that the higher lipid affinity of the isobutylene phase contributed to increased swelling, as expected. This novel method to calculate swelling coefficient effectively circumvents the inability of commonly-used thermal deswelling methods to characterize lipid and oil-induced swelling behavior; enabling better prediction of long-term *in vivo* performance of polymer-based biomedical devices and more accurate evaluation of lipid-induced degradation and swelling.

Keywords

Biocompatibility; lipids; degradation; plasticization; swelling