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THERMAL DEGRADATION OF POLY(LACTIC ACID) AND ACRYLONITRILE-BUTADIENE-STYRENE BIOBLEND: ELUCIDATION OF REACTION MECHANISMS

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Abstract

A reactive extrusion-calendering process (REX) was used in order to manufacture square plates with a nominal thickness of 3 mm of poly(lactic acid) (PLA) and its bioblend with acrylonitrile-butadiene-styrene (ABS). During processing, the properties of the melt were stabilized and enhanced by the addition of a styrene-acrylic multi-functional-epoxide oligomeric reactive agent (SAMfE). The general analytical equation has been used in order to evaluate the kinetic parameters of the thermal degradation of PLA-REX, ABS and its bioblend with a weight content of 70/30. Various empirical and theoretical solid-state mechanisms have been tested to elucidate the best kinetic model. In order to reach this goal, activation energy values were calculated by means of the Kissinger-Akahira-Sunose method. On the other hand, the standardized conversion functions have been constructed. Given that it is not always easy to visualize the best accordance between experimental and theoretical values of standardized conversion functions, a recently proposed index has been determined to quantitatively support our findings relative to the best reaction mechanisms. It has been demonstrated that the best mechanism for the thermal degradation of PLA-REX and ABS was the random scission of macromolecular chains. The bioblend thermal degradation occurred in two steps: the first step ($\alpha < 60\%$) took place through an R2 mechanism whereas the second step ($\alpha > 75\%$) did it according an F3 mechanism. Moreover, $y(\alpha)$ master plots have also been used in order to confirm that the selected reaction mechanisms were adequate.

Keywords: PLA; ABS; bioblend; kinetic models; general analytical equation; mechanism elucidation.

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