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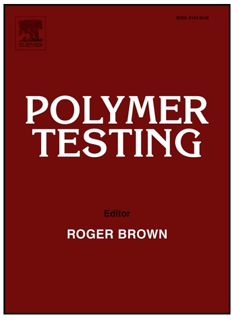

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Microstructure Characterization of Polyethylene using Thermo-rheological Methods

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Abstract

In the present work, we use the viscoelastic moduli of a large number of industrially available polyethylenes in order to evaluate/test some of the previously proposed correlations between levels of long chain branching and polydispersity with the rheological properties. These correlations together with some new ones can be used to correct for the effects of polydispersity or long chain branching in order to assess the effect of these two molecular features on the rheological properties independently. The effects of short and long chain branching are studied providing a methodology to detect rheologically levels of short and long chain branching.

Introduction

Polymers are extensively used in industry to fabricate plastic products using various processing techniques such as film blowing, thermoforming, and injection molding. Molecular and morphological characteristics such as molecular weight (Mw), molecular weight distribution (MWD), and branching along the backbone of the polymer chains govern the melt rheology of entangled polymers. To put this into a perspective, in the film blowing process a certain degree/distribution of long chain branching (LCB) within the matrix leads to a stable bubble. To overcome the issue of bubble instability, linear low density polyethylene (LLDPE) resins are often blended with small amount of low density polyethylene (LDPE) to increase the extensional viscosity inducing a more stable bubble. Since LCB characterization is inherently a challenging topic of vital importance in the plastic industry, it has drawn significant attention of various researchers previously.

The difficulty in microstructure characterization using rheology is due to two main factors. First, the production of polyethylenes of high Mw with well-defined levels, types, and distribution of long chain branching along the backbone is challenging. To this end, several studies were initiated on detecting subtle changes in polymer microstructure using rheology i.e. to differentiate between star, comb, pom-pom, comb-star, and dendritic long chain branched polymers [1–14]. Hierarchical relaxation was proposed as the mechanism by

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