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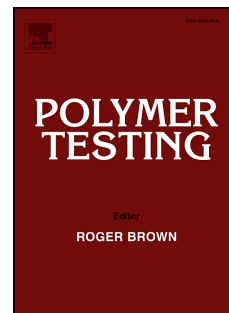
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Material Behaviour

Time-Sweep Rheometry for Evaluating Polyethylene Degradation Behavior: Effect of Formulation and Process Conditions

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ABSTRACT

A time sweep rheometry test was introduced to study polyethylene degradation through investigating its rheological behavior. Rheometry in the presence of air led to faster and more severe degradation of polyethylene. Higher temperatures shifted the onset of degradation to earlier times and increased the slope of the storage modulus-time curve. The application of different antioxidants (Irgafos 168 and Irganox 1010) can prevent and delay degradation through various routes. The most interesting modulus-time data were obtained in the case of samples containing Irganox 1010, for which, after the onset of degradation and storage modulus increase, there was a plateau for a while and then the storage modulus began to increase again. Such behavior was a characteristic of the presence of Irganox 1010 and its role as a long-term stabilizer. The results of both OIT and time-sweep rheometry measurements followed similar trends with changing the antioxidant composition.

Keywords: polyethylene degradation; time sweep rheometry; antioxidant; rheology; optimization

1. INTRODUCTION

Polyethylene is one of the most widely used polymer materials employed in a wide range of industries[1]. It is converted into final products by various processes, including extrusion, injection molding, blow molding, etc. during which the exposure of polyethylene to high shear stresses and temperatures increases the possibility of its degradation [2-10]. Moreover, the final product might be exposed to different environmental factors such as heat, UV and acidic/basic conditions which can degrade polyethylene [11-17].

Different additives are used to reduce or prevent polyethylene degradation [18-23]. Irganox 1010 and Irgafos 168 are two of the most widely used additives that are added to polyethylene powder to prevent degradation during processing[19, 23]. Irganox 1010 (a primary antioxidant) acts as a

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