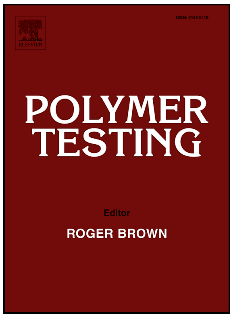

Characterisation of quasi-brittle fatigue crack growth in pipe grade polypropylene block copolymer

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PII: S0142-9418(14)00124-X
DOI: 10.1016/j.polymertesting.2014.05.016
Reference: POTE 4249

To appear in: *Polymer Testing*

Received Date: 1 April 2014

Accepted Date: 9 May 2014

Test Method

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Abstract

The aim of this work was to characterise quasi-brittle fatigue crack growth in a pipe grade polypropylene block copolymer. Cyclic cracked round bar specimen tests have been identified as a possible way to induce cyclic quasi-brittle crack growth within a reasonable amount of time. To ensure quasi-brittle failures, fracture surfaces have been examined using scanning electron microscopy. For further acceleration of the tests, higher temperatures with adapted load ranges have been applied. For 50°C and 80°C, a decrease in testing times of approx. 60% and 80% was achieved without significant changes in failure behaviour (e.g. cyclic crack opening displacement ($\Delta\delta$) curves or fracture surfaces) of the tested specimens. Relationships between applied load and testing times, as well as between crack initiation and failure have been examined. A change in ratio of crack initiation to total failure time was observed at higher temperatures. This has to be considered in future tests, especially when comparing different types of polypropylene at temperatures, differing from the real application.

Key Words

Block polypropylene, brittle fracture, cracked round bar specimen, fatigue

Introduction

Polypropylene is a widely used material in industrial applications. Besides extensive use as thin sheet (e.g. packaging) it has also been established for structural applications, such as pipes [1]. Therefore, the characterisation of long term properties and failure and fracture modes is crucial. There is extensive literature on the fracture behaviour of various types of unfilled and filled polypropylene used for injection moulding, compression moulding, etc. using linear elastic [2, 3], elastic plastic [2, 4, 5] or post-yield fracture mechanics [6]. However, most of this research focuses on polypropylene types not usable for structural applications such as pipes. For pipes, usually block- (PP-B), random- (PP-R), or homo polypropylene (PP-H) types with low melt flow rates (approx. 0.1 to 1 g/10 min) and high