Characterisation of Poly (ethylene naphthalate) -based polymer blends

by

Dylan Dae Bong Jung

Department of Mechanical Engineering

The University of Auckland

New Zealand

October 2002

A Thesis submitted in Partial Fulfilment of the Requirements

For

the Degree of Doctor of Philosophy in Engineering

Abstract

This investigation presents research on the characteristic properties of Nylon66 and poly(ethylene naphthalate) (Ny66/PEN), and poly(butylene terephthalate) and poly(ethylene naphthalate) (PBT/PEN) blends with several weight compositions made by melt blending, by the use of ^{13}C and ^{1}H Nuclear magnetic resonance (NMR), Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, X-ray photoelectron spectroscopy (XPS), Scanning electron microscopy (SEM), Differential scanning calorimetry (DSC) and Dynamic mechanical thermal analysis (DMTA), X-ray diffraction (X-RD), tensile, impact and stress relaxation tests.

Ny66/PEN blends including several additives do not improve the miscibility of the constituent polymers and show lower tensile strength than those of homopolymers. However, PBT/PEN blends reveal improved tensile strengths of the blends between the ROM and MROM predictions lines with more than 50 % volume fraction of PEN.

On the other hand, NMR spectra show no evidence of interchange reaction in both Ny66/PEN and PBT/PEN blends. SEM micrographs of fracture surfaces in PBT/PEN blends reveal a very small (sub-micron) domain size in contrast to large domains in Ny66/PEN blends, which indicates partial miscibility of PBT and PEN. DSC and DMTA demonstrate partial miscibility of PBT/PEN blends by the change of T_gs of each component according to the weight proportions of the constituent polymers.

Stress relaxation tests for the specimens of PBT/PEN blends and the homopolymers, using the Taguchi method of experimental design, determine that the most significant factor is the temperature, followed by PEN content and then the initial stress, and interaction effects between factors are insignificant. To fit the relaxation curves of the PBT/PEN blends and the homopolymers at different temperatures, PEN contents and initial stresses, four different equations have been used. The coefficients of the equation that fit best are used to predict the relaxation behaviour of PBT/PEN blends at a temperature between 30°C and 60°C, and at the initial stresses of 7 MPa.

Acknowledgements

The work described in this thesis was carried out at the Department of Mechanical Engineering and the Department of Chemistry, University of Auckland, under the supervision of Professor Debes Bhattacharyya in Mechanical Engineering and Associate Professor Allan Easteal in Chemistry.

I would like to thank them for their help and guidance during this research and express my gratitude to Associate Professor Paul Woodgate for assistance with the interpretation of NMR spectra and to Dr. Krishnan Jayaraman for the discussion of the viscoelasticity.

I wish to acknowledge help and trouble of lots of Technicians including Rex Halliwell, Jos Geurts, Barry Fullerton and Ivan Bailey in Mechanical Engineering, Mike Walker and Peter Buchanan in Chemistry, and Catherine Hobbis in Chemical and Material Engineering.

Thanks to my roommates, Keri Moyle, Temoana Southward, Jeroen van Houts, Baden Smith, David Simunic, Sharene Peterson, Xiaowen Yuan, Carrick Hill, Russell Dykes and Scott Ding.

Finally, I would like to express my thanks and appreciation to my wife and sons for their support, and to my mother and sisters and their families in Korea for their concerns during my long period of studies.

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