ADVANCES IN MATERIALS ENGINEERING

Volume 1

Edited By:
Zahurin Halim
Iskandar Idris Yaacob
Md Abdul Maleque

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Water Absorption of TPNR Reinforced Short Carbon Fibre Composite

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Keywords: Water absorption, short carbon fibre, composite, thermoplastic natural rubber, interphase.

Abstract. Thermoplastic natural rubber (TPNR) composite reinforced short carbon fibre (CF) was prepared via double melt blending method in internal mixer and then compression molded. Matrix of TPNR was at a ratio of NR:LNR:PP (20:10:70). TPNR matrix was reinforced with treated and untreated carbon fibre at 10, 20 and 30 vol% CF. TPNR-CF composites were tested for water absorption for about 60 days whereby all the composite specimens became saturated and uptake no more water. It was found that the treated composite absorbed less water at the same CF content. As expected, water uptake was higher with CF content especially at 30 vol% due to starvation of matrix thus led to fibre-to-fibre interaction and weaken the interphase of the TPNR composites.

Introduction

Thermoplastic elastomer (TPEs) blend has been broadly studied in respond to new class of materials. TPEs offer various advantages and required no state-of-the-art processing machinery, while scrap and rejects are recyclable [1]. Blends can be homogeneous, phase separated or both. TPEs are of multi-phase polymer systems consisting hard and soft domains that can be copolymers or mechanical blends. This phase separation yielding in materials having unique and viably commercialize physical properties. TPEs exhibited thermoplasticity characteristics of the hard thermoplastic phase, and resilience resulted from the rubbery domains [2]. TPEs based on natural rubber and thermoplastic blends are termed as thermoplastic natural rubber (TPNR) blends. There are two types of TPNR, namely thermoplastic polyolefin (TPO) and thermoplastic vulcanizate (TPV) [3].

In advanced composites, the excellent mechanical performances are primarily based on the properties of the fibres and the distribution of the fibres in the matrix. Generally, fibre-matrix interface is critical in determining the application of the composite. In fibre composite, fibre and matrix retain their physical and chemical properties, but they produce a good combination of mechanical properties that cannot be obtained from single constituents.

However, physical and chemical interactions between fibre and matrix formed a gradient structure known as interphase. Schematic diagram of interphase is illustrated in Fig. 1. Three main interactions may be occurred in polymer composite as described by Cahn et al. [4]:

a) Physico-chemical interactions involving surface energy and wetting behaviour of polymer
b) Chemical interactions / bonding
c) Mechanical interactions / mechanical interlocking

For short fibre composites, the presence of an interlayer will obviously affect the critical fibre length for pull-out since the shear strength of the interface is reduced. It was shown by Broutman