UNIVERSITI PUTRA MALAYSIA

CHARACTERIZATION OF MECHANICAL, MORPHOLOGICAL AND THERMAL PROPERTIES OF LOW DENSITY POLYETHYLENE NANOCOMPOSITE USING ALUMINA NANO-PARTICLES AS FILLER

JENNEY NGU LIM SONG

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By

JENNEY NGU LIM SONG

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Chair: Luqman Chuah Abdullah, PhD

Faculty: Engineering

Nano alumina was produced by using sol-gel method. Alumina was studied by using XRD, FTIR and TEM to confirm the spectroscopy of alumina and size. Ultrasonication was used to disperse the alumina and SDBS was used as surfactant to prevent the re-agglomeration. The processing conditions of LDPE/ alumina blending were studied. The optimum processing conditions was chosen based on tensile tests. The rotor speed during blending affected the dispersion of alumina in LDPE. The rotor speed 80 rpm gave the most consistent tensile properties, suggesting that the dispersion of alumina was good. Samples of 0.5, 1, 2, 3, and 5 wt% of alumina nanocomposite were prepared. Mechanical, thermal, and morphological properties were characterized. The addition of alumina into LDPE enhanced the tensile properties, i.e., tensile strength (34 - 43%) and Young's modulus (27 - 57%) of LDPE. The tensile fracture surfaces of the nanocomposites were characterized by SEM and confirmed the tensile results. From the flexural analysis, the presence of alumina has insignificant increment on both flexural

strength and flexural modulus. Impact strength for notched izod impact test was decreased at the low percentage of alumina loading. Dynamic mechanical analysis performed shown that T_g increased with the increase of alumina loading and damping value decreased with alumina loading. Thermal stability of the nanocomposites was studied by using TGA and no significant difference in stability was observed. Did not show great different of stability. Lastly, the crystallinity of nanocomposites was investigated with DSC. The crystallinity of nanocomposites decreased with the presence of alumina, because alumina restricts the movement of macromolecular chain in LDPE.

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PENCIRIAN MEKANIKAL, MORFOLOGI DAN TERMA PADA NANOKOMPOSIT POLIETILENA BERKETUMPATAN RENDAH DENGAN MENGGUNAKAN NANOPARTIKEL ALUMINA SEBAGAI PENGISI

Oleh

JENNEY NGU LIM SONG

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Pengerusi: Luqman Chuah Abdullah, PhD

Fakulti: Kejuruteraan

Nano alumina dihasilkan dengan menggunakan kaedah sol-gel. Alumina dikaji dengan menggunakan XRD, FTIR dan TEM untuk mengesahkan spektroskopi alumina dan saiz. Ultrasonikasi digunakan untuk menyerak alumina dan SDBS digunakan sebagai surfaktan untuk mencegah penggumpalan semula. Syarat-syarat pemprosesan bagi pengadunan LDPE/ alumina telah dipelajari. Syarat-syarat pemprosesan optimum itu adalah dipilih berdasarkan ujian tegangan. Laju pemutar semasa percampuran telah memberi kesan kepada penyerakan alumina dalam LDPE. Pada 80 rpm, ia membuktikan konsistensi ciri-ciri tegangan itu, dan boleh menyimpul yang penyerakan alumina itu adalah baik. Dengan syarat-syarat pemprosesan optimum, 0.5, 1, 2, 3, dan 5 wt% alumina nano-komposit telah disediakan. Ciri-ciri mekanikal, terma, dan mofologi disifatkan dengan pelbagai ujian. Tambahan alumina itu ke dalam LDPE meningkatkan ciri-ciri tegangan, iaitu, kekuatan tegangan (34-43%) dan modulus Young (27-57%) LDPE. Permukaan-

permukaan retakan tegangan nano-komposit SEM telah mengesahkan keputusan-keputusan tegangan itu. Daripada analisis lenturan, ia menunjukkan penambahan yang tidak menonjol pada kedua-dua kekuatan lenturan dan modulus lenturan dengan kehadiran alumina. Kekuatan hentaman daripada ujian hentaman izod berkurangan di peratus rendah pemuatan alumina. Analisis mekanik dinamik untuk LDPE/ alumina nano-komposit menunjukkan peningkatan T_g (suhu peralihan kaca) dengan tambahan alumina dan nilai redaman menurun. Kestabilan nanokomposites terma dikaji dengan menggunakan TGA (analisis thermograviti) tidak menunjukkan perbezaan kestabilan yang besar. Akhirnya, kehabluran nano-komposit telah disiasat dengan DSC (kalorimetri pengimbasan digital). Kehabluran nano-komposit telah menurun dengan kehadiran alumina, kerana alumina menghadkan pergerakan makromolekul rantai dalam LDPE.

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TABLE OF CONTENTS