CHARACTERIZATION OF CHITOSAN/MONTMORILLONITE HYBRID FILLED TAPIOCA STARCH NANOCOMPOSITE FILMS

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To my beloved father, mother, little brother and sister

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ABSTRACT

Biodegradable nanocomposite films from chitosan/montmorillonite (MMT) hybrid filled plasticized tapioca starch (TPS) were developed using a solution casting method. Chitosan was extracted from local shrimp shell resources with the degree of deacetylation of 60.85%. X-ray diffraction (XRD) analysis showed that the interlayer spacing of the chitosan/MMT/TPS nanocomposite films was slightly increased, indicated that the chitosan molecules were too large to intercalate into clay galleries. However, scanning electron microscopy (SEM) analysis found that the chitosan/MMT/TPS nanocomposite films producing more homogeneous distribution of MMT nanoclay particulate compared to the MMT/TPS nanocomposite films. Fourier transform infrared (FTIR) analysis showed that the shifting in amino group peak of chitosan indicated that the physical interaction occurred between hydroxyl groups (OH) of MMT and amino groups (NH_2) of chitosan. In addition, the broad stretch of OH was also shifted to lower wavelength number proven that hydrogen bonding was formed among starch, MMT and chitosan. It was found that the tensile properties improved in flexibility with moderate strength upon addition of chitosan in MMT/TPS nanocomposite films while the thermal stabilities improved upon addition of MMT in starch films but decreased with the addition of chitosan. The water vapor transmission rate of MMT/TPS films decreased after adding chitosan and the condition was the same for water absorption of the films. The light absorbance was also lowered upon addition of chitosan. Overall, addition of MMT and chitosan improved the TPS film properties that intended for packaging application purposes.

ABSTRAK

Filem komposit nano mesra alam bersumber kitosan/montmorilonit (MMT) hibrid terisi kanji berplastik ubi kayu (TPS) dihasilkan menggunakan teknik acuan larutan. Kitosan dihasilkan daripada kulit udang dari sumber tempatan dengan darjah pendeasetilan yang dicapai ialah 60.85%. Analisis belauan sinar-x (XRD) menunjukkan peningkatan jarak lapisan dalam filem kitosan/MMT/TPS adalah terlalu sedikit, menunjukkan bahawa molekul kitosan terlalu besar untuk masuk ke dalam lapisan galeri MMT. Walau bagaimanapun, analisis mikroskopi elektron penskanan (SEM) menunjukkan filem komposit nano kitosan/MMT/TPS mempunyai pembahagian MMT yang lebih sekata berbanding dengan filem komposit nano MMT/TPS. Berdasarkan analisis spektroskopi inframerah transformasi Fourier (FTIR), pergerakan puncak kumpulan amino kitosan telah menunjukkan berlakunya interaksi fizikal antara kumpulan hidroksil (OH) MMT dengan kumpulan amino (NH_2) kitosan. Sifat regangan didapati telah menunjukkan daya keanjalan yang lebih baik beserta dengan daya kekuatan yang sederhana telah dicapai dengan penambahan kitosan ke dalam filem komposit nano MMT/TPS disamping kestabilan terma meningkat selepas penambahan MMT tetapi menurun apabila kitosan ditambah. Kadar pergerakan wap air MMT/TPS menunjukkan penurunan selepas penambahan kitosan dan keadaan yang sama turut dicapai oleh kadar serapan air filem. Kadar penyerapan cahaya juga turut menurun selepas penambahan kitosan ke dalam filem. Keseluruhannya, penambahan kitosan dan MMT telah berjaya membaik pulih sifat-sifat filem TPS yang digunakan untuk aplikasi bahan pembungkusan.