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Characteristic study of polyethylene terephthalate (PET) used for commercial drinking bottles under uv radiation / Wee Nee Angeline.

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CHARACTERISTIC STUDY OF POLYETHYLENE TEREPHTHALATE (PET)  
USED FOR COMMERCIAL DRINKING BOTTLES  
UNDER ULTRAVIOLET (UV) RADIATION

By  
WEE NEE ANGELINE

A thesis submitted in partial fulfillment of  
the requirements for the award of the degree of  
Bachelor of Applied Science  
(Physics, Electronics and Instrumentations)

DEPARTMENT OF PHYSICAL SCIENCES  
FACULTY OF SCIENCE AND TECHNOLOGY  
UNIVERSITI MALAYSIA TERENGGANU  
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## **PENGAKUAN DAN PENGESAHAN LAPORAN PENYELIDIKAN SFZ 4399 A/B**

Adalah ini diakui dan disahkan bahawa laporan penyelidikan bertajuk: CHARACTERISTIC STUDY OF POLYETHYLENE TEREPHTHALATE (PET) USED FOR COMMERCIAL DRINKING BOTTLES UNDER ULTRAVIOLET (UV) RADIATION oleh WEE NEE ANGELINE, no. matrik: UK13706, telah diperiksa dan semua pembetulan yang disarankan telah dilakukan. Laporan ini dikemukakan kepada Jabatan Sains Fizik sebagai memenuhi sebahagian daripada keperluan memperoleh Ijazah Sarjana Muda Sains Gunaan (Fizik, Elektronik, & Instrumentasi), Fakulti Sains dan Teknologi, UMT.

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## DECLARATION

I hereby declare that this thesis entitled CHARACTERISTIC STUDY OF POLYETHYLENE TEREPHTHALATE (PET) USED FOR COMMERCIAL DRINKING BOTTLES UNDER ULTRAVIOLET (UV) RADIATION is the result of my own research except as cited in the references.

Signature :   
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Matrix No. : UK 13706  
Date : 30.4.2009

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## **CHARACTERISTIC STUDY OF POLYETHYLENE TEREPHTHALATE (PET) USED FOR COMMERCIAL DRINKING BOTTLES UNDER ULTRAVIOLET (UV) RADIATION**

### **ABSTRACT**

This paper studies the characteristics of polyethylene terephthalate (PET) used for commercial drinking bottles of different brands and colours after the photodegradation process under three different ultraviolet (UV) sources: sunlight, UV lamp with wavelength of 365 nm and UV lamp with wavelength of 254 nm. The tests that were carried out were tensile tests, Fourier Transform Infrared (FTIR) Spectroscopy and Scanning Electron Microscopy (SEM). After 250 hours of exposure to sunlight, the force at break and Young's Modulus were found to decrease up to 36.5% and 47.9% respectively. For samples exposed to 365 nm UV light radiation, the force at break and Young's Modulus were also found to decrease up to 52.7% and 54.9% respectively, which is higher than the effect of sunlight radiation. Meanwhile after 250 hours of exposure to 254 nm UV light, the force at break decreased up to 34.7% and the Young's Modulus decreased up to 17.5%. FTIR spectroscopy shows that the absorbance for samples exposed to the three UV sources decreases with increasing exposure time especially at peak  $1720\text{ cm}^{-1}$ , which signifies the carbonyl, C=O bond. This decrease in absorbance values shows that photodegradation of PET causes C=O bonds to break, where the longer the exposure time towards the UV source, the ability to absorb infrared by these bonds decreases. SEM images were obtained after the tensile tests and the difference between the topography of exposed and unexposed samples were shown.

# KAJIAN SIFAT POLYETHYLENE TEREPHTHALATE (PET) YANG DIGUNAKAN UNTUK BOTOL-BOTOL MINUMAN KOMERSIAL DI BAWAH SINARAN ULTRALEMBAYUNG (UV)

## ABSTRAK

Kajian telah dijalankan untuk mengkaji ciri-ciri *polyethylene terephthalate* (PET) yang digunakan untuk botol-botol minuman komersial dengan jenama dan warna yang berbeza setelah melalui proses fotodegradasi di bawah sinar ultralembayung (UV) daripada tiga sumber yang berbeza: cahaya matahari, lampu UV dengan panjang gelombang 365 nm dan lampu UV dengan panjang gelombang 254 nm. Ujian-ujian yang telah dijalankan adalah ujian regangan, spektroskopi *Fourier Transform Infrared* (FTIR) dan Mikroskopi Pengimbasan Elektron (SEM). Selepas 250 jam pendedahan terhadap cahaya matahari, daya untuk putus dan nilai pekali Young telah didapati menyusut masing-masing sehingga 36.5% dan 47.9%. Bagi sampel-sampel yang didedahkan kepada cahaya UV dengan panjang gelombang 365 nm, nilai-nilai daya untuk putus dan pekali Young juga didapati menurun masing-masing sebanyak 52.7% dan 54.9%, lebih tinggi daripada nilai-nilai yang didapati selepas pendedahan kepada cahaya matahari. Sementara itu selepas tempoh 250 jam pendedahan terhadap cahaya UV dengan panjang gelombang 254 nm, daya yang diperlukan untuk memutuskan sampel-sampel juga berkurangan sehingga 34.7% dan 17.5% untuk nilai pekali Young. Spektroskopi FTIR menunjukkan bahawa nilai serapan untuk sampel-sampel yang telah didedahkan kepada kedua-dua sumber UV berkurangan dengan meningkatnya masa pendedahan pada terutamanya pada  $1720\text{ cm}^{-1}$ , yang menandakan ikatan C=O. Hasil kajian ini menunjukkan bahawa pengurangan nilai-nilai serapan yang disebabkan oleh proses fotodegradasi menyebabkan ikatan C=O berpecah, di mana semakin meningkatnya masa pendedahan ke sumber UV, keupayaan untuk menyerap inframerah oleh ikatan ini menurun. Imej-imej imbasan SEM telah diperolehi selepas sampel-sampel menjalani ujian regangan dan perbezaan antara topografi sampel-sampel yang tidak terdedah kepada UV dan sampel-sampel yang terdedah ditunjukkan.