

**UNIVERSITI TEKNOLOGI MARA**

**THERMAL PROPERTIES AND MORPHOLOGIES  
OF POLY(ETHYLENE TEREPHTHALATE) IN  
BLENDS WITH EPOXIDIZED NATURAL  
RUBBERS**

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Thesis submitted in fulfilment of the requirements  
for the degree of  
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## Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

In the event that my thesis is found to violate the conditions mentioned above, I voluntarily waive the right of conferment of my degree and agree to be subjected to the disciplinary rules and regulations of Universiti Teknologi MARA.

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## ABSTRACT

### THERMAL PROPERTIES AND MORPHOLOGIES OF POLY(ETHYLENE TEREPHTHALATE) IN BLENDS WITH EPOXIDIZED NATURAL RUBBERS

Thermal properties and morphologies for polymer blends of poly(ethylene terephthalate) (PET) and epoxidized natural rubber with 25 mole % (ENR-25) and 50 mole % epoxy content (ENR-50) were studied by using differential scanning calorimeter (DSC) and polarizing optical microscope (POM). The blends were prepared by precipitation method. Immiscibility of the components is revealed by observation of two glass transition temperatures ( $T_g$ ) that correspond to that of the neat constituents. Equilibrium melting points ( $T_m^0$ ) of PET in blends was determined by applying Hoffman-Weeks step-wise annealing procedure. The  $T_m^0$  of neat PET and PET in the blends are around 260 °C. The degree of crystallinity of PET in blends with ENR-25 and ENR-50 remains constant. The rate of crystallization of PET in blends is characterized by the reciprocal half time ( $t_{0.5}^{-1}$ ). It displays an Arrhenius-like behavior with respect to temperature and it stays constant at isothermal crystallization temperature,  $T_c = const$  as long as PET is in excess. Rate of crystallization of PET in the blends decreases exponentially as the  $T_c$  increases. Dispersed phase of ENR-25 and ENR-50 in the matrix of PET can be observed when the content of PET is excess.

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## CHAPTER 1

### INTRODUCTION

#### 1.1 General

Polymer or macromolecule is a large molecule built by covalently bonded above 10 or 20 monomers or the Constitutional Repeating Unit (CRU) in any possible pattern [1 – 3]. Acceptance of the macromolecular hypothesis came about in the 1920's, largely because of the efforts of Staudinger (1920) [4] who proved the existence of large long-chain structures for polystyrene, rubber and polyoxymethylene. The bloom of the demand of polymeric materials is broadly extended with applications in many areas and its increase has been prompt since after Second World War.

In recent years, huge demand for engineering plastics specialty elastomers, fibers and other polymeric materials with improved properties and processibility of the materials may be satisfied by changes in macromolecular design of the materials [5]. Hence, the developments of new polymeric materials through regulating the macromolecular architecture [6] and/or by blending with existing polymers [7 – 10] have attained much attention for the academic purposes as well as for the industries [11 – 12].

#### 1.2 Polymer Blending

Most of the studies on polymer blends focused on two aspects which are first by fundamental understanding of theoretical aspect then followed by the technological