

UNIVERSITI TEKNOLOGI MARA

**PROCESSING AND
CHARACTERIZATION OF BIO-
BASED POLYMER DERIVED FROM
Tacca leontopetaloides STARCH WITH
RICE HUSK SILICA AND NATURAL
RUBBER BLENDS**

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Thesis submitted in fulfilment
of the requirements for the degree of
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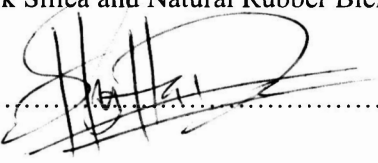
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AUTHOR'S DECLARATION

I declare that the work in this thesis/dissertation 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 degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

The non-renewable source of petroleum based plastic such as Polyethylene (PE), calls for a need to look into this natural based polymer. Polylactic acid (PLA) is the promising synthetic polymer which is derived from the natural monomer lactic acid extracted from starch such as corn starch; whereby need to compete as a staple food. Therefore, in this research, new source of starch called *Tacca leontopetaloides* is introduced, which has potential to be utilized as raw material to produce biopolymer such as bio-thermoplastic elastomers. The incorporated plasticized *Tacca* starch and matrix natural rubber filled with silica from rice husk and sulphur vulcanization by using two roll-mill machine is producing a bio-thermoplastic elastomer. The chemical, thermal and mechanical study was done on two formulations, firstly to evaluate the effect of volume plasticizers and secondly to study the effect of natural rubber and glycerol ratio in the blending process. The best mechanical and thermal characteristic was then compared with PE/NR/Silica and PLA/NR/Silica blends as a standard TPE. Among the TPEs, TPE15 with 50:6 natural rubber to glycerol ratio had showed higher tensile strength at 1.467 MPa and elongation at break at 265 mm with higher thermal resistant leaving 24.8 % amount of residue at 500 °C. This property is highly achieved the minimum tensile needed for floor mat production at 0.294 MPa with minimum elongation at 200 mm. Based on this, *Tacca leontopetaloides* starch plasticized with glycerol and filled with silica rice husk has the capability to replace synthetic raw material used in producing bio-thermoplastic elastomer floor mat for car industry.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF STUDY

Plastic from petroleum based product such as Polyethylene (PE) is a pioneer material for polymer industries. Its high resistant towards high temperature, low water absorption and strong mechanical properties made this raw material to be the most wanted. At 1920s, when there were rapid growth new inventions in polymer industries, new polymer material called thermoplastic elastomer (TPE) was created, wherein, the polymer with thermoplastic properties was physically mixed with the polymer with elastomeric properties [1]. The usage of high density polyethylene (HDPE) in blending with Natural rubber (NR) to prepare the material with thermoplastic elastomer characteristic was investigated by Pandey and Setua [2]. The blends were mixed in the Brabender Plasticorder and the damping behavior of rubber blends was studied. There are huge application of thermoplastic elastomer for example foam, soft and hard thermal insulation sheets, door and window handles for household and automotive, house hold plastic furniture etc. [3].

The increasing demands of thermoplastic elastomers in the market led to expand the viable sources of raw materials into the cheaper and renewable types of material. In addition, the high level of concern for a clean and safe environment for the future helps to support this effort. Thus, starch as it placed under natural polymer has been one of the most wanted material to help in the replacing the usage of synthetic polymer. This natural polymer promotes plastic properties and some rubbery properties with the presence of plasticizer such as glycerol. Besides glycerol, sorbitol, urea and even formaldehyde are used as plasticizer.

When the plastic properties from this natural polymer were mixed with synthetic rubber, then it is called as bio-polymer. Natural rubber extracted from *Havea Brasiliensis* plant is widely used together with starch to produce biopolymer. Carvalho *et al.*, [4] had blended thermoplastic starch from corn starch with latex natural rubber (NR) directly in