

**UNIVERSITI TEKNOLOGI MARA**

**SYNTHESIS AND  
CHARACTERIZATION OF  
NANOPARTICLE RESIN DERIVED  
FROM MALEINATED SOYBEAN OIL**

**NUR SAFWAH BT BASRI**

Thesis submitted in fulfilment  
of the requirements for the degree of  
**Master of Science**

**Faculty of Applied Sciences**

**December 2013**

## **AUTHOR'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 degree or qualification.

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

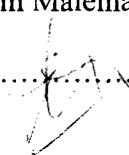
Name of student : Nur Safwah Bt Basri

Student I.D. No. : 2010298286

Programme : Master of Science

Faculty : Faculty of Applied Sciences

Title derived : Synthesis and Characterization of Nanoparticle Resin From Maleinated Soybean Oil

Signature of Student :  .....

Date : December 2013

## ABSTRACT

A study of characteristic and properties of Maleinated Soybean Oil (MSO) synthesized from different mole ratio of Maleic Anhydride and Epoxidized Soybean Oil (ESO) has been studied. Increase in acid value, the reduction of oxygen oxirane content and the color changes shows the grafting process of MA onto epoxy group of ESO. Molecular weight and viscosity of MSO is higher than ESO indicates the inclusion of carboxylic group and the values are increased with increase of MA mole ratio. MSO-1.5 was utilized for waterborne dispersion preparation due to its better properties compared with others. The MSO-1.5 was dispersed with different amount of deionized water to produce waterborne Maleinated Soybean Oil dispersion (WMSO). Nano-sized particle was confirmed through particle size testing by using particle size analyzer. Increased in molecular weight and reduction of acid value and viscosity of water-borne dispersion can be seen as volume of de-ionized water in dispersion increased. WMSO was cured by exposing under UV radiation and its physical, thermal and surface performance was investigated. Based on Differential Scanning Calorimetric (DSC) and Thermogravimetric analyzer (TGA), dispersion with smaller nano-sized particle possesses high film glass transition temperature ( $T_g$ ) and degradation temperature. Film surface hardness determined by pencil hardness testing was increased with decreasing of particle size of dispersion. The adhesion of film with glass substrate was poor due to low adhesion with substrate. Through film morphology analysis, smooth surface was observed for all film samples. Wettability and surface energy of film was determined using water contact angle analyzer. Results from the contact angle showed that the high water content water-borne film sample made up with high water content have good wettability and possesses low surface energy compared with others due to the higher film surface polarity.

## ACKNOWLEDGEMENT

The acknowledgement goes especially to the most merciful, Allah S.W.T who made all things possible.

I would like to acknowledge and extend my heartfelt gratitude to the following persons who made the completion of my research project possible. I am most indebted to my supervisor, PM Dr Rahmah Mohamed, and my co-supervisor, En Ahmad Faiza Mohd for their expertise, guidance and taught in order for me to hurdle all the obstacles upon completion of my graduate study.

Most importantly, none of this would have been possible without the love and patience of my family. My parents, Basri Bin Jasmo and Siti Nazirah Bt Marsandi to whom this thesis is dedicated to, has been a constant source of love, concern, support and strength all these years. Many friends have helped me stay sane through these difficult years. For all my friends, Siti munira, Nor Nadiah, Munirah, Faruq, Adillah, Naiman, Hafiz and Khairul thank you for their relentless concern and moral support. I am also indebted 'The 411 Polymer Lab's Clan' for their help and sharing ideas. Their support and care helped me overcome setbacks and stay focused on my graduate study. I greatly value their friendship and I deeply appreciate their belief in me.

I am very grateful for the gracious cooperation and assistance by laboratory staff of Polymer Lab (En. Anuar Ibrahim, Pn. Nurul Hayanti and En. Nizam). I do appreciate the financial aid from Postgraduate Service Scheme by Universiti Teknologi MARA that sponsoring me throughout my graduate study.

Lastly, I would like to say thank you to any particular person who involved directly or not during completion of my research work and thesis writing.

## TABLE OF CONTENTS

	<b>Page</b>
<b>AUTHOR'S DECLARATION</b>	<b>ii</b>
<b>ABSTRACT</b>	<b>iii</b>
<b>ACKNOWLEDGEMENT</b>	<b>iv</b>
<b>TABLE OF CONTENT</b>	<b>v</b>
<b>LIST OF TABLES</b>	<b>ix</b>
<b>LIST OF FIGURES</b>	<b>x</b>
<b>LIST OF ABBREVIATIONS</b>	<b>xiv</b>
<b>CHAPTER ONE: INTRODUCTION</b>	
1.1 Background	1
1.2 Problem Statement	3
1.3 Objective of Study	4
1.4 Scope Limitation	5
<b>CHAPTER TWO: LITERATURE REVIEW</b>	
2.1 Utilization of Green Resources and New Converting Petroleum Based Fuel	6
2.2 Vegetable Oil	6
2.2.1 Types of Vegetables	9
2.3 Soybean Oil	10
2.3.1 Structure and Its Properties	10
2.4 Epoxidized Soybean Oil	11
2.4.1 Structure of Epoxidized Soybean Oil	11
2.4.2 Epoxidation Process	12
2.5 Maleic Anhydride	14