

**A STUDY ON DEGRADATION OF PALM-BASED  
POLYURETHANE BY USING *Escherichia coli***

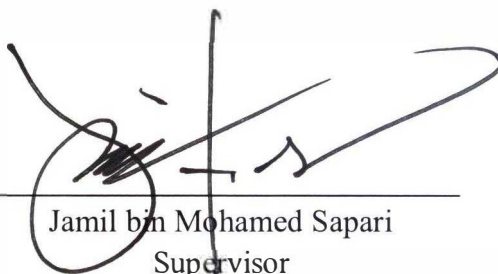
**NUR 'AISYAH BINTI OTHMAN**

**Final Year Project Report Submitted in  
Partial Fulfilment of the Requirements for the  
Degree of Bachelor of Science (Hons.) Chemistry  
in the Faculty of Applied Sciences  
Universiti Teknologi MARA**

**JANUARY 2017**

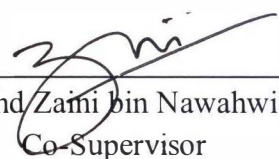


This Final Year Project entitled “**A Study on Degradation of Palm-Based Polyurethane by Using *Escherichia coli***” was submitted by Nur ‘Aisyah binti Othman, in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Chemistry, in the Faculty of Applied Sciences, and was approved by




---

Jamil bin Mohamed Sapari  
Supervisor  
School of Chemistry and Environments  
Faculty of Applied Sciences  
Universiti Teknologi MARA  
72000 Kuala Pilah  
Negeri Sembilan



---

Mohd Zamri bin Nawahwi  
Co-Supervisor  
School of Biology  
Faculty of Applied Sciences  
Universiti Teknologi MARA  
72000 Kuala Pilah  
Negeri Sembilan



---

Dr. Sheikh Ahmad Izaddin bin Sheikh  
Mohd Ghazali  
Project Coordinator  
School of Chemistry and Environments  
Faculty of Applied Sciences  
Universiti Teknologi MARA  
72000 Kuala Pilah  
Negeri Sembilan



---

Mazni binti Musa  
Head of Programme  
School of Chemistry and Environments  
Faculty of Applied Sciences  
Universiti Teknologi MARA  
72000 Kuala Pilah  
Negeri Sembilan

Date: 8/2/2017

## TABLE OF CONTENTS

	Page
<b>ACKNOWLEDGEMENT</b>	ii
<b>TABLE OF CONTENTS</b>	iii
<b>LIST OF TABLES</b>	v
<b>LIST OF FIGURES</b>	vi
<b>LIST OF ABBREVIATIONS</b>	vii
<b>ABSTRACT</b>	viii
<b>ABSTRAK</b>	ix
<b>CHAPTER 1 INTRODUCTION</b>	
1.1 Background of study and problem statement	1
1.2 Significance of study	5
1.3 Objectives of study	6
<b>CHAPTER 2 LITERATURE REVIEW</b>	
2.1 Polyurethane	7
2.2 Preparation of polyurethane	8
2.2.1 Palm oil-based polyurethane	9
2.2.2 Soybean oil-based polyurethane	13
2.2.3 Castor oil-based polyurethane	14
2.2.4 Rapeseed oil-based polyurethane	15
2.3 Polyurethane degradation	16
2.3.1 Natural and accelerated degradation	16
2.3.2 Fungal degradation	17
2.3.3 Gamma radiation degradation	17
2.3.4 Thermal degradation	18
2.3.5 Bacterial degradation	19
2.3.5.1 <i>Pseudomonas aeruginosa</i>	20
2.3.5.2 <i>Bacillus subtilis</i>	21
2.4 <i>Escherichia coli</i>	22
<b>CHAPTER 3 METHODOLOGY</b>	
3.1 Materials	23
3.2 Methods	23
3.2.1 Preparation of palm kernel oil-based polyol	25
3.2.2 Preparation of palm-based polyurethane	25
3.2.3 Degradation process	26
3.2.3.1 Media preparation and culture condition	26
3.2.3.2 Degradation of polyurethane in bacteria	27

3.2.4	Characterization of degraded PU-foam	27
-------	--------------------------------------	----

**CHAPTER 4 RESULTS AND DISCUSSION**

4.1	Palm kernel oil-based polyol	29
4.2	Morphology test of <i>Escherichia coli</i>	32
4.3	FTIR analysis of polyurethane	33
4.4	Weight loss of polyurethane	36
4.5	SEM analysis of polyurethane	39

**CHAPTER 5 CONCLUSION AND RECOMMENDATIONS**

5.1	Conclusion	41
5.2	Recommendations	42

<b>CITED REFERENCES</b>	43
-------------------------	----

<b>APPENDICES</b>	46
-------------------	----

<b><i>CURRICULUM VITAE</i></b>	56
--------------------------------	----

## ABSTRACT

### A STUDY ON DEGRADATION OF PALM-BASED POLYURETHANE BY USING *Escherichia coli*

Palm kernel oil-based polyol was successfully synthesized in this study by the transesterification and condensation process which the raw palm kernel oil was mixed with the polyhydric compound. The rigid polyurethane was formed from the reaction of polyol and isocyanates with ratio of 1:1. The issue of non-biodegradability of petroleum-based polyurethane can be overcome by substituting with the edible plant oil-based polyurethane such as the palm kernel oil-based polyurethane. This type of polyurethane is advantageous compared to petroleum-based polyurethane as the process is relatively safe and also simple. The ability of *E.coli* to degrade polyurethane was determined by Fourier Transform Infrared Spectroscopy (FTIR) analysis, Scanning Electron Microscope (SEM) analysis and percentage weight loss. The percentage weight loss was calculated within 2 weeks with 3 days intervals to identify the effect of different bacterial concentration on the rate of degradation of polyurethane. The results showed an increasing percentage of weight loss with increasing bacterial concentration. The FTIR analysis showed a significant decrease in intensity of ester (C=O) bond peak absorb at  $1728\text{ cm}^{-1}$  as ester is susceptible to be hydrolyzed during degradation process by *E.coli*. The morphological structure analysis of polyurethane was observed using SEM showing a destruction on the surface of polyurethane after degradation proving that *E.coli* was able to degrade polyurethane.