

**KINETIC DIFFUSION OF TOLUENE THROUGH VULCANIZED
NATURAL RUBBER COMPOSITE**

NUR HAFIZATUL AIZA BT MOHAMED SILAH

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

FEBRUARY 2022

This Final Year Project Report entitled “**Kinetic Diffusion of Toluene Through Vulcanized Natural Rubber Composite**” was submitted by Nur Hafizatul Aiza Binti Mohamed Silah in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Applied Chemistry, in the Faculty of Applied Science and was approved by

Assoc. Prof. Dr. Razif Bin Muhammed Nordin
Supervisor
B. Sc. (Hons.) Applied Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
02600 Arau
Perlis

Ts. Muhammad Salihin Bin Zakaria
Co-Supervisor
B. Sc (Hons.) Materials Engineering
Faculty of Chemical Engineering Technology
Universiti Malaysia Perlis
02600 Arau
Perlis

Dr. Nurlia Binti Ali
Coordinator
B.Sc.(Hons.) Applied Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
02600 Arau
Perlis

Dr Zuliahani Binti Ahmad
Head of Programme
B. Sc. (Hons.) Applied Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
02600 Arau
Perlis

Date: 17 February 2023

ABSTRACT

KINETIC DIFFUSION OF TOLUENE THROUGH VULCANIZED NATURAL RUBBER COMPOSITE

Oil spills are a major problem for people all over the world. They not only demand the environment but also human health and aquatic life. Many methods have been used to clean up oil spills to solve this problem. In recent years, researchers have focused on using polymers to absorb the oil in a spill. The diffusion of toluene through vulcanized natural rubber(NR) has been studied using swelling tests. Toluene is used to simulate the phenomenon oil spill. The NR was vulcanized with Dicumyl peroxide. Peroxide-crosslinking depends on temperature and curing time. The NR/DCP was characterized by using Fourier transform infrared spectroscopy (FTIR). The FTIR absorption spectra reveal the characteristic peaks and estimated intensity of peaks. NR was undergoes swelling test by immerse into toluene to obtain diffusion parameter. The dependence of diffusion coefficient, sorption, permeability and transport mechanism was investigated. The higher the temperature and the longer the curing time, the lower the diffusion of the solvent through polymer. The kinetic adsorption was fitted to the pseudo-first-order.

TABLES OF CONTENT

ABSTRACT	i
ABSTRAK	ii
ACKNOWLEDGEMENT	iii
TABLES OF CONTENT.....	iv
LIST OF TABLES	vii
LIST OF FIGURE.....	viii
LIST OF SYMBOLS.....	x
LIST OF ABBREVIATIONS.....	xi
CHAPTER 1 INTRODUCTION.....	1
1.1 Background of study	1
1.2 Problem statement	5
1.3 Significance of study	7
1.4 Objectives of study	8
1.5 Scope and Limitation of Study	9
CHAPTER 2 LITERATURE REVIEW	10
2.1 Rubber and it properties	10
2.1 Vulcanization of Rubber.....	16
2.2 Vulcanization Rubber with Organic Peroxide.....	18
2.3 Comparison of Sulfur and Peroxide	21
2.4 Characterization of Vulcanization rubber	23
2.5 Solvent Diffusion Through Polymer	24

2.6	Diffusion in Polymer Dependence on Crosslink Density.....	27
CHAPTER 3 METHODOLOGY		29
3.1	Materials & Chemicals	29
3.2	Instrumentations	29
3.2.1	Characterization using Fourier transform infrared spectroscopy (FTIR)	30
3.2.3	Density measurement	31
3.2.4	Swelling Tests	31
3.2.5	Kinetic studies	35
3.2.6	Crosslink Density	35
3.3	Procedure.....	37
3.3.1	Vulcanization Process	37
3.3.2	Characterization NR.....	38
3.3.3	Swelling tests.....	39
CHAPTER 4 RESULT AND DISCUSSION		42
4.1	Attenuated total reflection Fourier transform infrared spectroscopy (FTIR)	42
4.2	Diffusion studies.....	48
4.2.1	Transport Mechanism of Toluene	51
4.2.1	Transport Parameter (Diffusivity Coefficient, Sorption Coefficient and Permeability)	54