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**CURING KINETIC OF NATURAL RUBBER
UNDER CONVENTIONAL VULCANIZATION SYSTEM
WITH INCORPORATION OF SODIUM BICARBONATE**

Name : NURIEN NADHIRAH BINTI HERREAMY
Student ID : 2022484792
Program : AS222
Course code : FSG671
Mobile Phone :
E-mail : nurienadhirah19@gmail.com

Approval by Main Supervisor :

I certify that the work conducted by the above student is completed and approve this report to be submitted for evaluation.

Supervisor's name : ASSOC. PROF. DR. RAZIF MUHAMMED NORDIN
Date : 13/02/2026
Turnitin Similarity % : 11%
Signature :

ASSOC. PROF. DR. RAZIF MUHAMMED NORDIN
DEPARTMENT OF CHEMISTRY
FACULTY OF APPLIED SCIENCES
UNIVERSITI TEKNOLOGI MARA, PERLIS
BRANCH, ARAU CAMPUS, 02800 PERLIS

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NURIEN NADHIRAH BINTI HERREAMY

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This Final Year Project entitled **“CURING KINETIC OF NATURAL RUBBER UNDER CONVENTIONAL VULCANIZATION SYSTEM WITH INCORPORATION OF SODIUM BICARBONATE”** was submitted by Nurien Nadhirah in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Chemistry with Management in the Faculty of Applied Sciences, and was approved by

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

Mdm Farhana binti
Othman,

Project Coordinator
B. Sc. (Hons.)
Chemistry with
Management
Faculty of Applied
Sciences Universiti
Teknologi MARA
02600 Arau
Perlis

Dr. Nasulhah
binti Kasim

Head Center of
Studies
B. Sc. (Hons.)
Chemistry with
Management
Faculty of Applied
Sciences Universiti
Teknologi MARA
02600 Arau
Perlis

Date : _____

ABSTRACT

CURING KINETIC OF NATURAL RUBBER UNDER CONVENTIONAL VULCANIZATION SYSTEM WITH INCORPORATION OF SODIUM BICARBONATE

This research examines the curing kinetics, activation energy (E_a), tensile properties, chemical structure, and surface morphology of natural rubber (NR) composites prepared via a conventional sulfur vulcanization (CV) system, with and without sodium bicarbonate (NaHCO_3) acting as a blowing agent. Two NR composites were prepared: a control sample (0 phr NaHCO_3 /NR) and a modified compound containing 8 phr NaHCO_3 . Curing behaviour was also assessed through Moving Die Rheometer (MDR) but the interpretation of kinetic behaviour was done using pseudo-first-order and pseudo-second-order models. Arrhenius relationship was used to calculate the E_a values. Analysis of MDR torque showed that NaHCO_3 addition substantially shortened scorch time (t_{s2}) and raised the cure rate index (CRI), which suggests a decrease in the cure initiation rate. But it has lower maximum torque (M_H) and torque changes (ΔM) value, indicating density of crosslinks formation reduced in the process, as the porous structure is formed during vulcanization. Both NR composite curing profile were established to be pseudo-first-order in nature. As 8 phr NaHCO_3 was added, the E_a of the vulcanization increased from 118.23 kJ/mol to 157.59 kJ/mol, indicating that more thermal energy was needed to form the crosslinks in the modified composite. This was explained by the endothermic reaction of NaHCO_3 and reaction with the activators, which modified the curing process. Though NaHCO_3 increased curing window stability at elevated temperatures, the tensile strength and elongation at break (E_b) decreased as a result of the formation of microvoids that caused local stress concentration. Moreover, FTIR analysis showed no other dominant peaks showing that the initial chemical structure of NR did not change. Peaks at 1440cm^{-1} and 1640cm^{-1} were attributed to CH_2 scissoring vibrations and stearic acid-zinc interactions respectively which overlapped the carbonate and carbonyl signals from NaHCO_3 breakdown. The optical microscopic observation revealed the control sample had more dense and uniform morphology, while the NaHCO_3 -modified composite had closed cell structures which were uniformly distributed throughout the rubber matrix. This suggests that there was control in the release of the gases during vulcanization. Overall, NaHCO_3 primarily influenced the kinetic and physical properties of NR vulcanization without causing significant chemical alteration. The findings highlight the potential of NaHCO_3 as a controlled blowing agent for developing foamed NR composites.

TABLE OF CONTENTS

	Page
ABSTRACT	III
ABTRAK	IV
ACKNOWLEDGEMENT	VI
TABLE OF CONTENT	VII
LIST OF TABLES	IX
LIST OF FIGURES	X
LIST OF SYMBOLS	XII
LIST OF ABBREVIATIONS	XIII
CHAPTER 1 INTRODUCTION	
1.1 Research Background	1
1.2 Problem Statement	5
1.3 Research Questions	6
1.4 Objectives	6
1.5 Significance of study	7
1.6 Expected Outcomes	8
CHAPTER 2 LITERATURE REVIEW	
2.1 Introduction	10
2.2 NR and Its Application	12
2.2.1 Relevant Background Information	13
2.2.2 Current Trend and Issues	15
2.2.3 Spesific Focus Area	18
2.3 Research Flowchart	20
2.4 Research Gap	23
CHAPTER 3 METHODOLOGY	
3.1 Introduction	25
3.2 Research Design	25
3.3 Material	26
3.4 Processing	27
3.4.1 Mixing Procedure	29
3.5 Cure Characteristics	31