

**UNIVERSITI TEKNOLOGI MARA**

**IMMOBILIZATION OF CARBONIC  
ANHYDRASE ENZYME INTO SOLID  
SUPPORT FOR SEQUESTRATION  
OF CARBON DIOXIDE**

**SITI NADIA BTE ABDULLAH**

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

**Faculty of Chemical Engineering**

May 2018

## **CONFIRMATION BY PANEL OF EXAMINERS**

I certify that a Panel of Examiners has met on 29th September 2017 to conduct the final examination of Siti Nadia bte Abdullah on his Master of Science thesis entitled “Immobilization Carbonic Anhydrase Enzyme into Solid Support for Sequestration of Carbon Dioxide” in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

Assoc. Prof. Dr Noor Fitrah Abu Bakar, PhD  
Senior Lecturer  
Faculty of Chemical Engineering,  
Universiti Teknologi MARA  
(Chairman)

Dr Norliza Ibrahim, PhD  
Senior Lecturer  
Faculty of, Chemical Engineering,  
Universiti Teknologi MARA, UITM  
(Internal Examiner)

Assoc. Prof. Dr Rashidah Abdul Rahim, PhD  
Programme Manager  
School of Biological Sciences,  
Universiti Sains Malaysia, USM  
(External Examiner)

**MOHAMMAD SR DR HJ ABDUL HADI  
HJ NAWAWI**

Dr.  
Dean  
Institute of Graduates Studies  
Universiti Teknologi MARA  
Date : 24 May 2018

## **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 results 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.

Name of Student : Siti Nadia bte Abdullah

Student I.D. No. : 2014688826

Programme : Master of Science – EH 750

Faculty : Chemical Engineering

Thesis : Immobilization of Carbonic Anhydrase Enzyme into  
Solid Support for Sequestration of Carbon Dioxide

Signature of Student : .....

Date : May 2018

## ABSTRACT

The rapid accumulation of carbon dioxide (CO<sub>2</sub>), one of the greenhouse gasses has led to the climate change issues. To reduce the uncontrolled CO<sub>2</sub> emission, there are various technologies of carbon capture. Among of the techniques, biological approach is getting attention due to the drawbacks of chemical and physical techniques. In biological approach, introduction of carbonic anhydrase (CA) enzyme enhanced the hydration reaction of CO<sub>2</sub>. Enzyme immobilization is one of the techniques for improving enzyme stabilities, but there are limited studies of suitable carriers for CA. Thus, the objective of present study was conducted on the biocharacterization of immobilized CA on PVDF membrane and amberlite XAD7. Based on the findings, immobilized CA onto PVDF membrane performed higher enzyme activity as compared to amberlite XAD7. The thermal stability of immobilized CA for both support materials were achieved at 60°C, which is 20°C higher than free CA. Meanwhile, pH stability of immobilized CA has also shifted to pH 10 as compared with free CA at pH 9. For kinetics study, the kinetics parameters for K<sub>m</sub>, V<sub>m</sub> and K<sub>cat</sub> value for immobilized CA onto PVDF membrane was 7.5 mmol/L, 0.76 μmol/min and 0.13 min<sup>-1</sup> respectively. In carbonation process of CO<sub>2</sub> using immobilized CA, the time taken for a complete carbonation reaction time was 52.5s, which is faster compared to blank solution with 55.5s at enzyme optimum temperature. The enzyme accelerates the carbonation reaction up until its optimum stability. As a conclusion, PVDF membrane was suitable as a support material for immobilized CA due to the higher of enzyme activity performance and possess better value of kinetics parameters.

# TABLE OF CONTENTS

	<b>Page</b>
<b>CONFIRMATION BY PANEL OF EXAMINERS</b>	<b>1</b>
<b>AUTHOR'S DECLARATION</b>	<b>2</b>
<b>ABSTRACT</b>	<b>3</b>
<b>ACKNOWLEDGEMENTS</b>	<b>4</b>
<b>TABLE OF CONTENTS</b>	<b>5</b>
<b>LIST OF TABLES</b>	<b>9</b>
<b>LIST OF FIGURES</b>	<b>10</b>
<b>LIST OF SYMBOLS</b>	<b>12</b>
<b>LIST OF ABBREVIATIONS</b>	<b>15</b>
<b>CHAPTER ONE: INTRODUCTION</b>	<b>17</b>
1.1 Background of Study	17
1.2 Problem Statement	19
1.3 Objective of Study	20
1.4 Scope of Research	20
1.5 Significant of Study	21
<b>CHAPTER TWO: LITERATURE REVIEW</b>	<b>22</b>
2.1 Situation of CO <sub>2</sub> in Atmosphere	22
2.1.1 Physical and Chemical Characteristic of CO <sub>2</sub>	22
2.1.2 Current Situation of CO <sub>2</sub> in Atmosphere	23
2.1.3 Available Technologies for Carbon Capture	24