

**THERMAL CHARACTERISTICS OF EUTECTIC MIXTURES  
OF FATTY ACIDS AS PHASE CHANGE MATERIAL**

**By**

**ROZANNA DEWI**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,  
in Partial Fulfilment of the Requirements for the Degree of Master of Science**

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*Terima kasih kepada  
Abah dan mama  
Serta suami  
Yang selalu membantu dalam menyelesaikan study ini*

Abstract of project presented to the Senate of Universiti Putra Malaysia in partial fulfilment of the requirement for the degree of Master of Science

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**Chairman : Chuah Teong Guan, PhD**

**Faculty : Engineering**

Latent heat storage in phase change material (PCM) is one of the efficient ways of storing thermal energy. In latent heat storage, energy is stored in a small mass/volume with a narrow temperature transition between melting and solidifying. This study aims to investigate the effect of using eutectic mixtures of fatty acids as PCM in building material such as gypsum board, palm-based and petrochemical-based polyurethane. Gypsum is widely used in construction industry due to its low cost. It is considered as a good supporting material for thermal energy storage since it has 41% air voids. The choice of polyurethane (PU) is made because of its increase uses in the construction industry.

There were four type of eutectic mixture of fatty acids used in this work, which are lauric-stearic acids (75.5:24.5 w/w %), myristic-palmitic acids (58:42 w/w %), palmitic-stearic acids (64.2:35.8 w/w %) and capric – lauric acids (65:35 w/w %).

Differential Scanning Calorimetry (DSC) analysis showed that binary mixture of fatty acid form eutectic mixture that have a definite melting/solidification points with a sharp peak and no additional hump. The latent heat for the mixtures is considered high compared to other PCM.

DSC analysis showed that the thermal characteristics such as melting point, melting ranges, solidification point and solidification ranges of fatty acid impregnated in host material, are identical to fatty acid before impregnation. The latent heat of PCM was higher after impregnated in host material as an effort is needed to break the internal bond between PCM and host material. SEM analysis demonstrated that pore structure of host material was not influenced by the immersion process. Indeed, the hardness of host material remained as original.

Abstrak thesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi sebahagian keperluan untuk Ijazah Master Sains dalam Kejuruteraan Kimia.

**PENCIRIAN HABA CAMPURAN CAMPURAN EUTEKTIK ASID  
LEMAK SEBAGAI BAHAN TUKAR FASA PADA SEBAGIAN  
BAHAN BANGUNAN**

Oleh

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Simpanan haba muatan dalam bahan tukar fasa adalah salah satu cara yang berkesan untuk menyimpan tenaga haba. Dalam simpanan haba muatan tersebut, tenaga disimpan dalam satu jisim/isipadu yang kecil dan satu peralihan suhu yang sempit antara perleburan dan perbekuan. Pengajian ini bertujuan untuk menyiasat kesan penggunaan campuran eutektik asid lemak sebagai bahan tukar fasa dalam bangunan seperti papan gypsum, panel polyuretene berasas minyak sawit atau petrokimia. Gypsum adalah digunakan secara meluas dalam industri pembinaan dan berkos rendah. Ia dianggap sebagai bahan sokongan yang baik untuk simpanan tenaga terma disebabkan ia mempunyai 41% lompong udara. Pilihan poliuretene dibuat adalah kerana penggunaannya dalam industri pembinaan telah meningkat.

Empat jenis campuran eutektik asid lemak digunakan dalam kerja ini, iaitu asid laurik-sterik (75.5:24.5 w/w %), asid miristik-palmitik (58:42 w/w %), asid palmitik-sterik (64.2:35.8 w/w %) dan asid kaprik – laurik (65:35 w/w %). Analisis “Differential Scanning calorimetry (DSC)” menunjukkan bahawa campuran perduaan asid lemak telah membentuk campuran eutektik (campuran yang memiliki satu takat lebur/pembekuan yang tentu) dengan satu puncak yang tajam dan tiada bonggol tambahan yang berlaku. Haba muatan dianggap lebih tinggi berbanding dengan jenis bahan tukar fasa lainnya.

Analisis DSC menunjukkan selepas asid lemak diisikan dalam bahan perumah, ciri-ciri terma bahan tukar fasa seperti takat lebur, julat peleburan, takat beku dan julat pembekuan adalah lebih kurang sama dengan asid lemak sebelum diisikan. Haba muatan bahan tukar fasa yang lebih tinggi selepas diisikan dalam bahan perumah disebabkan tenaga yang perlu memecahkan ikatan dalaman antara bahan tukar fasa dengan bahan perumah. Analisis SEM menunjukkan struktur liang bahan perumah tidak dipengaruhi oleh proses perendaman. Manakala, kekerasan bahan perumah kekal sama seperti yang asal.

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*Nona 2004*

## APPROVAL

I certify that the Examination Committee meet on February 3<sup>rd</sup>, 2005 to conduct the final examination of Rozanna Dewi on his Master of Science in Chemical Engineering thesis entitled “**Thermal Characteristics of Some Eutectic Mixtures of Fatty Acids as Phase Change Material in Selected Building Materials**” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded a relevant degree. Members of the Examination Committee are as follows:

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## **DECLARATION**

I hereby declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously or co currently submitted for any other degrees at UPM or other institutions.

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**ROZANNA DEWI**  
Date: August 2004

## TABLE OF CONTENTS

	Page
<b>DEDICATION</b>	ii
<b>ABSTRACT</b>	iii
<b>ABSTRAK</b>	v
<b>ACKNOWLEDGEMENTS</b>	vii
<b>APPROVAL</b>	viii
<b>DECLARATION</b>	x
<b>LIST OF TABLES</b>	xiii
<b>LIST OF FIGURES</b>	xv
<b>LIST OF ABBREVIATIONS</b>	xix
<b>CHAPTER</b>	
<b>1. INTRODUCTION</b>	1.1
1.1 Solar Energy As Alternative Energy	1.1
1.2 Thermal Energy Storage (TES)	1.2
1.3 Phase Change Material (PCM) as Thermal Energy Storage	1.3
1.4 Application of PCMs as Thermal Energy Storage	1.3
1.5 Method of Implement PCM in Building Material	1.4
1.6 Problem Statement	1.6
1.7 Objective	1.8
<b>2. LITERATURE REVIEW</b>	2.1
2.1 Classification of Phase Change Materials (PCMs)	2.1
2.2 Phase Change Materials (PCMs) Properties	2.3
2.3 Alternative Materials as Energy Storage	2.4
2.4 Fatty Acids as Phase Change Materials (PCMs)	2.6
2.5 Melting and Solidification Behaviours of PCMs	2.9
2.6 Heat Transfer Background Theory	2.14
2.7 The Experimental Studied of Fatty Acids and Its Mixture as PCMs	2.16
2.8 Fatty Acids as Phase Change Material (PCM) in Building Application	2.23
2.9 Characteristics of Host Material	2.29
2.9.1 Gypsum	2.29
2.9.2 Polyurethane	2.29
2.10 Differential Scanning Calorimetry (DSC)	2.32
<b>3. METHODOLOGY</b>	3.1
3.1 Preparation of Materials	3.1
3.1.1 Preparation of Eutectic Mixtures of Fatty Acids	3.1
3.1.2 Preparation of Gypsum Wallboard	3.2
3.1.3 Preparation of Polyurethane Panel	3.3
3.2 Experimental Method	3.4
3.2.1 Immersion Process	3.4
3.2.2 Testing Differential Scanning Calorimetry (DSC)	3.5
3.2.3 Measurement of Open Cell Content of Polyurethane	3.6

3.2.4	Measurement of Thermal Conductivity	3.7
3.2.5	Measurement of hardness	3.7
3.2.6	Scanning Electron Microscope (SEM) Analysis	3.8
<b>4.</b>	<b>RESULTS AND DISCUSSIONS</b>	<b>4.1</b>
4.1	Thermal Characteristics of Eutectic Mixtures of Fatty Acids	4.1
4.2	Loading of PCM as a Function of Immersion Time	4.5
4.3	Thermal Characteristics of Polyurethane and Gypsum After Impregnated with PCM (Eutectic Mixtures of Fatty Acids)	4.7
4.4	Scanning Electron Microscope (SEM) Analysis	4.23
4.5	Effects of Temperatures	4.25
<b>5.</b>	<b>CONCLUSION</b>	<b>5.1</b>
5.1	Conclusions	5.1
5.2	Future Study	5.2
	<b>REFERENCES</b>	<b>R.1</b>
	<b>APPENDICES</b>	
	<b>APPENDIX A</b>	<b>A.1</b>
	<b>APPENDIX B</b>	<b>B.1</b>
	<b>BIOGRAPHY OF THE AUTHOR</b>	
	<b>LISTS OF PUBLICATION</b>	