

**UNIVERSITI TEKNOLOGI MARA
CAWANGAN PULAU PINANG**

**ELECTROMAGNETIC
CHARACTERIZATION OF
PYRAMIDAL KENAF MICROWAVE
ABSORBER**

**SITI NORFAZLIN BINTI MOHAMAD
RADHI**

**BACHELOR OF ENGINEERING
(HONS) ELECTRICAL AND
ELECTRONIC ENGINEERING**


July 2020

AUTHOR'S DECLARATION

I acknowledge that the research in this thesis was completed in compliance with the Universiti Teknologi MARA standards. It is genuine and is the result of my own research, unless otherwise specified or recognized as referenced work.

I accordingly accept that I have been issued with the Universiti Teknologi MARA Academic Rules and Regulations regulating the conduct of my studies and research.

Name of Student : Siti Norfazlin Binti Mohamad Radhi
Student I.D. No. : 2016263844
Programme : Bachelor of Engineering (Hons.) Electrical and
Electronic Engineering - EE200
Faculty : Electrical Engineering
Thesis : Electromagnetic Characterization of Pyramidal Kenaf
Microwave Absorber

Signature of Student : 

Date : July 2020

ABSTRACT

Microwave absorber is designed to absorb radiation and reduce it. The anechoic chamber RF is surrounded by absorbers which would eliminate unnecessary signals of reflection. The objective of this paper is to investigate new materials and techniques for the absorption performance of electromagnetic waves in order to develop differentiate the characteristic pyramidal microwave absorbers with commercial absorber using kenaf with a certain size. There are two designs introduced which are solid and hollow pyramidal microwave absorbers. For solid pyramidal consist of 10.2 cm long X 10.2 cm wide with base height of 5.7 cm and 10.2 cm long X 10.2 cm wide with pyramid height of 25.4 cm. The absorber's fabrication cannot be continued because of the pandemic problem. Therefore, the design process is carried out using the CST software program in the frequency spectrum from 1 to 12GHz for 16 simulation with different properties which are consider with 3 different height, 3 different value of dielectric constant and 2 different value of Z_{pos} for both of solid and hollow pyramid. Kenaf is an advancement in improving the design of the anechoic chamber pyramidal microwave radio frequency absorber (RF). The pyramidal microwave absorber is designed to use the kenaf, as this advanced research mixture will be investigated to determine the best pyramidal microwave absorber reflectivity or reflection loss efficiency. Carbon was the most critical element which really helped the absorber absorb completely unacceptable microwave signals. A mixed material is designed to evaluate the performance of reflective loss in the frequency range from 1GHz to 12GHz of microwave absorber. Overall , based on all measurements, the best minimum absorption output design is -30 dB and below which the solid pyramid design means just -20 dB for absorption efficiency compared with the hollow achievement. This project's design would concentrate on improving the absorption performance and whether it can replace the industrial-based commercial absorber.

ACKNOWLEDGEMENT

I am thankful to God in Allah 's name for the good health and wellbeing that was needed to complete this final year project. My grateful appreciation go out to my supervisor, Ts Nazirah Mohamat Kasim. For the continued support of my degree thesis and related work, for her patience, encouragement, and detailed knowledge. Her encouragement has helped me in the study and writing process of this thesis. I could not have imagined getting an excellent research advisor and mentor for my study.

I record my sincere appreciation to Dr. Haji Hasnain for his interesting suggestions and inspiration, but also for his insights that inspired me to enhance my research from different perspectives. I also appreciate the staff, lecturer, in the Electrical Engineering Department. I am deeply thankful and respectful to them for sharing their knowledge, and have extended to me meaningful and effective encouragement and advice.

I also want to thank all my friends' group mates for the stimulating interactions and discussions, for the sleepless nights we worked together before deadlines and for all the fun we had in the last year. I also would like to thank all my friends at the UiTM Pulau Pinang educational establishment. I also record my sense of appreciation to each and every one who have lent their hand in this journey, directly or indirectly.

Last but not least, I would really like to thank my family, my parents and my sisters and brothers for spiritually supporting me throughout most of the completion of this thesis and of my entire life.

TABLE OF CONTENTS

	PAGE
AUTHOR'S DECLARATION	i
ABSTRACT	ii
ACKNOWLEDGEMENT	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vii
LIST OF FIGURES	viii
LIST OF SYMBOLS	x
LIST OF ABBREVIATIONS	xi
CHAPTER 1 INTRODUCTION	12
1.1 OVERVIEW	12
1.2 BACKGROUND OF STUDY	12
1.3 PROBLEM STATEMENT	14
1.4 OBJECTIVES	14
1.5 SCOPE OF STUDY	15
1.6 THESIS ORGANISATIONS	16
CHAPTER 2 LITERATURE REVIEW	17
2.1 OVERVIEW	17
2.2 ELECTROMAGNETIC WAVE	17
2.3 ANECHOIC CHAMBER	20
2.4 MICROWAVE ABSORBER	21
2.4.1 Solid and Hollow design of Pyramid microwave absorber	23
2.5 RADIATION ABSORBING MATERIALS	24
2.5.1 Jaumann Absorbers	24
2.5.2 Salisbury Screen	26
2.5.3 Dallenbach layer	27
2.6 BIOMASS COMPOSITE MATERIAL	29
2.6.1 Kenaf Fibre	29

2.6.2	Carbon	30
2.6.3	Rice Husk	31
2.6.4	Bamboo Charcoal	32
2.7	DIELECTRIC PROPERTIES	32
2.7.1	Electric Permittivity	33
2.7.2	Reflectivity Coefficient	34
 CHAPTER 3 METHODOLOGY		 35
3.1	OVERVIEW	35
3.2	FLOWCHART	35
3.3	COMPUTER SIMULATION TECHNOLOGY (CST) MICROWAVE STUDIO SOFTWARE	38
3.3.1	Verification of simulation	38
3.3.2	Fabrication of Pyramidal Absorber Design	39
3.3.3	Modelling of pyramidal absorber design on CST Microwave Studio	41
 CHAPTER 4 RESULTS AND DISCUSSIONS		 47
4.1	OVERVIEW	47
4.2	SIMULATION SETUP	47
4.2.1	Reflectivity performance of EHP absorber produced by ETS LINDGREN Company	47
4.2.2	Reflectivity performance of commercial wedge absorber using free space arch measurement.	50
4.2.3	Comparison reflectivity performance by varying the value of pyramid height for solid and hollow design.	51
4.2.4	Comparison reflectivity performance by varying the dielectric constant for Solid and Hollow design.	55
4.2.5	Comparison reflectivity performance by varying the distance of absorber from the waveguide port for Solid and Hollow design.	59
4.2.6	Comparison reflectivity performance for the best maximum and minimum point by varying the value of distance Z_{pos} of absorber, the height of pyramid and the dielectric constant value for Solid	