

**THE DIELECTRIC CONSTANT (ϵ') AND LOSS TANGENT (δ) OF
MAGNETITE (Fe_3O_4) FILLED THERMOPLASTIC NATURAL
RUBBER COMPOSITE**

FARAHANIS MARUDIN

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

JULY 2017

ABSTRACT

THE DIELECTRIC CONSTANT (ϵ') AND LOSS TANGENT (δ) OF MAGNETITE (Fe_3O_4) FILLED THERMOPLASTIC NATURAL RUBBER COMPOSITE

A Thermoplastic Natural Rubber filled with Magnetite Composite was prepared by melt blending. For preparation of Pure TPNR, polypropylene (PP) and natural rubber (NR) in the percentage weight ratio of 70:30 and preparation of TPNR filled with Magnetite, the percentage weight ratio of 70% TPNR and 30% of Magnetite were used by using Rheo internal mixture. Pure TPNR is prepared as a control sample. Then, samples were hot pressed to form pellet samples. Dielectric constant (ϵ') and tangent loss (δ) are measured by using Network Vector Analyzer (NVA). The homogeneity samples was confirmed by using Thermogravimetric Analyser (TGA) PerkinElmer model in the temperature range of 25°C -700°C at a heating rate of 10°C min⁻¹ in a nitrogen gas atmosphere with a purge rate of 20 mL min⁻¹. Dielectric constant and tangent loss were measured using Network Vector Analyzer at frequency range of 8-12GHz. TPNR filled with magnetite showed the higher dielectric constant compared to control sample. The frequency dependent dielectric constant shows the TPNR filled with Magnetite was higher than control sample. The tangent loss of control sample was higher compared to the sample TPNR filled with Magnetite. The value of loss tangent and dielectric constant were consistent with frequency 8-12 GHz. As a conclusion, the introduction of Magnetite into TPNR was increase in dielectric constant and decrease in loss tangent.

TABLE OF CONTENTS

	PAGE
ACKNOWLEDGMENTS	iii
TABLE OF CONTENTS	iv-v
LIST OF TABLES	vi
LIST OF FIGURE	vii-viii
LIST OF ABBREVIATIONS	ix
ABSTRACT	x
ABSTRAK	xi
CHAPTER 1 INTRODUCTION	
1.1 Background and problem statement	1
1.2 Material of Thermoplastic	3
1.2.1 Natural rubber	4
1.2.2 Polypropylene (PP)	5
1.2.3 Thermoplastic Natural Rubber (TPNR)	6
1.2.4 Ferrites	7
1.2.5 Magnetite (Fe_3O_4)	8
1.3 Significance of study	9
1.4 Objectives of study	10
CHAPTER 2 LITERATURE REVIEW	
2.1 Characteristic of Magnet	11
2.2 Theory Microwave Absorber	12
2.3 Reflection	14
2.4 Dielectric constant	15
2.5 Dielectric loss	16
2.6 Loss Tangent	17
2.7 Thermogravimetric analysis	19
2.8 Wave guide	21
CHAPTER 3 METHODOLOGY	
3.1 Introduction	23
3.2 Materials	23
3.3 Preparation of Pure TPNR	23
3.4 Preparation of Thermoplastic Natural Rubber (TPNR) filled Magnetite.	26
3.5 Preparation of pellet for characterize	30
3.6 Characterizations	33
3.6.1 Measurement of dielectric constant and tangent loss	33

3.6.2 Thermogravimetric analysis	38
----------------------------------	----

CHAPTER 4 RESULT AND DISCUSSION

4.1 Thermogravimetric Analysis (TGA) on the Composite	40
4.2 Performance of the Dielectric Constant	44
4.3 Performance of Loss Tangent	47

CHAPTER 5 CONCLUSION

5.1 Homogeneity	51
5.2 Dielectric Constant	51
5.3 Tangent Loss	52
5.4 Recommendation	52

CITED REFERENCES	53
-------------------------	-----------

APPENDICES	57
-------------------	-----------

CURRICULUM VITAE	64
-------------------------	-----------

LIST OF TABLES

TABLE	CAPTION	PAGE
Table 4.1	The Dielectric Constant of Pure TPNR (70%PP, 30%NR)	44
Table 4.2	The Dielectric Constant of TPNR Filled Magnetite Composite (70%TPNR, 30%Magnetite)	44
Table 4.3	The loss tangent of pure TPNR (70% PP, 30% NR)	48
Table 4.4	The loss tangent of TPNR filled Magnetite (70%TPNR, 30% Magnetite)	48
Table A.1	Dielectric constant for Pure TPNR, TPNR filled Magnetite and frequency	57
Table A.2	Loss tangent for Pure TPNR, TPNR filled Magnetite and frequency	60