UNIVERSITI PUTRA MALAYSIA

DEVELOPMENT OF MICROWAVE LEVEL DETECTION OF MULTILAYER LIQUIDS IN BIODIESEL PRODUCTION

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By

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

April 2011

Dedicated

To

This thesis is dedicated to my beloved Father and Mother, MRS Zahra Sheikh Zadeh and my Supervisor Prof kaida Khalid for his kindly help during my study.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in Fulfilment of the Requirement for the degree of Master of Science

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Chairman: Professor Kaida Khalid, PhD

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Biodiesel is a fuel which is produced from a reaction between a type of fat and alcohol in the presence of a catalyst to accelerate the reaction. The production process is divided into two main parts: transesterification and washing process.

After transestrification, glycerin and some residuals were produced and settled under the biodiesel while water settled down under the biodiesel after the washing process. Therefore, there is a need to determine the biodiesel-glycerin interface after transesterification process and biodiesel-water after washing process. These steps are important for accurate release of glycerin from the container in order to prevent wasting of biodiesel and to retain good quality of biodiesel.

Microwave as a method for level measurement can help to detect the position of each layer. Our objectives are based on the moving up and down of an X-band (10.70 GHz) microwave sensor inside the container to measure the level of each layer. Simulation of the theoretical principles of various liquid detection and

determination of the purity of washed biodiesel are achieved through the comparison between dielectric constants of materials. The microwave detection system is monitored by a PC through a program in LABVIEW 8.5 environment which receive data from the sensor, control stepper motor movement and analyze and plot the final output based on the amplitude of the reflected wave and distance.

The theoretical principles of the detection of multilayer system are simulated by MATLAB program for detection of glycerin-biodiesel after transesterification and water-biodiesel after the washing processes separately. The behavior of the reflected was studied at a distance of 160 mm. Comparing the simulation results and level measurement shows the experimental results are in good agreement with theoretical values. As our main work is based on the changes of the permittivity elements, it is measured after each time of the washing process through VNA (Vector Network Analyzer) and recalculated from the reflection profile again by the present mathematical method. This method calculates the dielectric constant through the relation between elements of permittivity, phase constant and attenuation.The error between these methods is about ±0.6.

By comparing dielectric of washed biodiesel at each washing with pure biodiesel, it is possible to determine the purity of biodiesel. Generally the results show the developed system be able to give the accuracy of level detection of about ±0.1 mm and for the liquid height of 160 mm, it takes around 18 minutes to complete the measurement. In conclusion, the software based design has been developed which can determine the interface level and purity of biodiesel furthermore. It is flexible, easy to control, low cost and user friendly.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PEMBANGUNAN TAHAP PENGESANAN MIKROWAVE BAGI BERBAGAI CECAIR DALAM PENGHASILAN BIODISEL

Oleh

MAHMOUD HOMAIEE SERESHT

April 2011

Pengerusi: Profesor Kaida Khalid, PhD

Fakulti: Sains

Biodiesel merupakan bahan bakar yang dihasilkan daripada tindakbalas bahan lemak dan alkohol yang dimangkin untuk mempercepatkan tindakbalas. Proses pengeluaran ini terbahagi kepada dua bahagian utama : proses pembersihan dan transesterifikasi. Setelah transestrifikasi, gliserin dan beberapa sisa akan terwujud lalu mendak di bawah biodisel, air juga akan turun dan mendak di bawah cecair biodisel selepas proses pembersihan.

Oleh itu ia memerlukan kajian untuk menentukan bentuk biodisel-gliserin selepas proses transestrifikasi dan biodisel-air selepas pembersihan. Langkah-langkah ini sangat perlu bagi menentukan penghasilan gliserin yang tepat dari bekasnya dan menghalang kehilangan biodisel untuk membentuk biodisel yang berkualiti.

Kaedah mikrowave bagi tahap pengukuran dapat membantu pengesanan kedudukan bagi tiap-tiap lapisan. Objektif kami berdasarkan kepada pergerakan ke atas dan ke bawah Band-X (10.70 GHz) sensor mikrowave di dalam bekas untuk mengukur

tahap setiap lapisan. Simulasi bagi prinsip-prinsip teori pengesanan berbagai cecair dan penentuan kesahihan biodisel yang dibersihkan dapat dicapai melalui perbandingan antara bahan pemalar dielektrik. Sistem pengesanan mikrowave dipantau oleh PC melalui program dalam LABVIEW 8.5 yang menerima data dari sensor , pergerakan kawalan motor stepper dianalisis dan diplot keluaran akhir berdasarkan kepada jarak dan besarnya pantulan gelombang. Prinsip-prinsip teori pengesanan sistem multilayer disimulasikan dengan program MATLAB untuk mengesan biodisel-gliserin selepas transesterifikasi dan biodesel-air selepas proses pembersihan berasingan. Keadaan tindakbalas dikaji pada jarak 160mm. Perbandingan hasil simulasi dan pengukuran tahap menunjukkan hasil ujikaji yang bersesuaian dengan nilai-nilai teoritikal.

Sebagai tugas utama kami berdasarkan kepada elemen perubahan permitiviti, ia diukur setiap kali selepas proses pembersihan melalui VNA (Vector Network Analyzer) dan dikira semula daripada profail tindakbalas menggunakan metod pengiraan sedia ada. Kaedah ini menghitung pemalar dielektrik melalui hubugkait antara elemen permittiviti, fasa tetap dan cair. Kadar kesalahan bagi kedua-dua kaedah ini hanya ± 0.6. Dengan perbandingan dielektirk bagi pembersihan biodisel dan pembersihan dengan biodisel jati adalah munasabah untuk menentukan ketulenan biodesel. Secara keseluruhannya hasil kajian menunjukkan sistem yang dihasilkan dapat menentukan ketetapan tahap pengesanan lebih kurang ±0.1mm dan bagi ketinggian cecair 160mm, pengukuran mengambil masa 18 minit bagi keseluruhannya. Kesimpulannya bentuk asas perisian telah diperkembangkan bagi menentukan hubungkait tahap dan ketulenan biodisel dan selain itu perisian ini mudah dikawal, kos yang murah dan mudah digunakan.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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DECLARATION

I declare that the thesis is my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently submitted for any other degree at Uninersity Putra Malaysia or other institutions.

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MAHMOUD HOMAIEE SERESHT

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TABLE OF CONTENTS

		Page
DEDICATION		ii
ABSTRACT		iii
ABSTRAK		v
ACKNOWLEDGEMENTS		vii
APPROVAL		viii
DECLARATION		x
LIST OF TABLES		xiii
LIST OF FIGURES		xiv
LIST OF ABBREVIATIONS		xvii
LIST OF SYMBOLS		xviii
CHAPTER		
1	**INTRODUCTION**	
	1.1 Background	1
	1.2 Biodiesel Production Process	2
	1.3 Level Detection Methods in Tank	7
	1.4 aim and objectives	8
	1.5 Thesis Outline	9
2	**LITERATURE REVIEW**	
	2.1 Common Level Detection Methods	11
	2.2 Microwave Measurement Techniques for Level Detection	12
	2.2.1 Non-Resonant Method	12
	2.2.2 Reflection Method	13
	2.3 Review on the Background of Multilayer System	15
	2.4 Conclusion of Literature	19
3	**THEORY OF MICROWAVE SENSOR AND LEVEL DETECTION**	
	3.1 Principle of Measurement	21
	3.2 Reflection Type system of level meter	22
	3.3 Masson Non Touching Loop Rules	24
	3.3.1 Calculation of Reflection Coefficient for multilayer System	25
	3.4 Determination the purity of Biodiesel	37
4	**METHODOLOGY**	
	4.1 General Description of the Detection system Setup	40
	4.2 Microwave Sensor	42
	4.2.1 Test Method of Sensor	45
	4.3 Stand and Holders	46
	4.4 Stepper Motor and Its Controller	46
	4.5 Digital Multimeter	50

4.6 Power Supply 52
4.7 I/O card 53
4.8 PC 54
4.8.1 Labview Programming Environment 55
4.9 Biodiesel Production 61
4.10 The Washing Process 62
4.11 Dielectric Properties Measuremen 64

5 **RESULTS AND DISCUSSION**
5.1 Simulation Results 66
5.2 Detection of Multilayer System before Washing Process 72
5.3 Detection of Multilayer for after Washing Process 73
5.4 Detection of the Purity of Biodiesel 76
5.5 Summary 79

6 **CONCLUSION AND FUTURE DIRECTION**
6.1 Conclusion 81
6.2 Recommendations for Future Work 83

REFERENCES 84
APPENDIX I 87
BIODATA OF STUDENT 93
LIST OF PUBLICATIONS 94