DEVELOPMENT OF A 500MHz REFLECTOMETER USING STRIPLINE COUPLER FOR MOISTURE MEASUREMENT OF OIL PALM FRUITS

By

LEE KIM YEE

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

July 2004

To My Family and Friends.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science

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Chairperson : Zulkifly Abbas, Ph.D.

Faculty : Science and Environmental Studies

This thesis describes the development of a cost effective PC-based reflectometer for the determination of moisture content in oil palm fruits to gauge its degree of ripeness. The PC-controlled reflectometer which operates at 500 MHz consists of a stripline directional coupler, two diode detectors, a data acquisition card and two open-ended coaxial sensors. The design, analysis and performance of the stripline directional coupler in conjunction with the open-ended coaxial sensors for moisture content determination of oil palm fruits are described in detail. Simulations have been carried out to predict the variation in the reflection coefficient with moisture content in oil palm fruits. A computer program has also been developed to control the data acquisition card as well as to calculate the reflection coefficient using Agilent Visual Environment Engineering (VEE) graphical programming software. The performance of the reflectometer was tested by comparing

reflection coefficient results obtained from the commercial HP4195A Network/Spectrum Analyzer. Calibration equations relating the measured reflection coefficient using the reflectometer to the moisture content found by using standard oven drying method has been established. The accuracies of the calibration equations were determined by comparing the predicted moisture content with the moisture content using standard oven drying method on 50 different fruit samples and were found to be in good agreement within 5 %. The reflectometer provides a simple, fast and accurate method compared to the conventional method in monitoring the various stages of fruit ripeness.

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

PEMBANGUNAN METER PANTULAN 500MHz MENGGUNAKAN PENGANDING BERARAH TALIAN JALUR UNTUK MENGUKUR KELEGASAN BUAH KELAPA SAWIT

Oleh

LEE KIM YEE

Julai 2004

Pengerusi : Zulkifly Abbas, Ph.D.

Fakulti : Sains dan Pengajian Alam Sekitar

Tesis ini memperihalkan pembinaan meter pantulan berkomputer untuk menentukan kandungan kelegasan dalam buah kelapa sawit seterusnya untuk mengukur tahap kematangan buah kelapa sawit. Meter pantulan yang dikawal oleh komputer ini beroperasi pada 500 MHz dan terdiri daripada satu pengandingan berarah talian jalur, dua pengesan diod, satu kad pungutan data, dan dua penderia sepaksi hujung terbuka. Rekabentuk, analisis dan prestasi pengganding berarah talian jalur bersama penderia sepaksi hujung terbuka untuk penentuan kelegasan dalam buah kelapa sawit diterangkan dengan terperinci. Simulasi turut dilakukan untuk meramal perubahan pekali pantulan terhadap kelegasan dalam kelapa sawit. Satu perisian pengukuran telah dibina untuk mengawal kad pungutan data dan seterusnya untuk mengira pekali pantulan dengan mengunakan perisian program grafile Agilent VEE. Prestasi meter pantulan ini telah diuji

dan dibandingkan dengan keputusan pekali pantulan daripada HP4195A Penganalisis Rangkaian Vector/Penganalisis Spektrum komersial. Persamaan tentukuran berkaitan dengan pekali pantulan yang diukur menggunakan meter pantulan terhadap kelegasan yang ditentukan dengan kaedah piawai pengeringan oven telah hasil. Kejituan persamaan tentukuran ini telah ditentukan dengan membandingkan kelegasan ramalan dengan kelegasan sebenar menggunakan kaedah piawai pengeringan oven terhadap 50 biji buah kelapa sawit yang berlainan. Kejituan adalah saling memusakan dalam lingkungan 5%. Meter pantulan menyediakan cara mudah, cepat dan jitu berbanding cara lama untuk menentukan tahap kematangan buah kelapa sawit.

ACKNOWLEDGEMENTS

The author wishes to thank his family members for their love, support and encouragement as well as for always being there for him.

The author extends his deepest gratitude to the chairman of the supervisory committee, Dr. Zulkifly Abbas, for his kindness, guidance, suggestions, and his willingness to help.

The author also wishes to thank the members of the supervisory committee, Prof. Dr. Kaida Khalid and Dr. Jumiah Hassan for their advice, supervision and guidance.

Appreciation is also given to all the staffs in the Electromagnetic Lab for their assistance and help. Lastly, I am deeply grateful to all the lecturers, staffs in Physics Department and friends for their unreserved help and motivations.

I certify that an Examination Committee met on 15 July 2004 to conduct the final examination of Lee Kim Yee on his Master of Science thesis entitled "Development of a 500MHz Reflectometer Using Stripline Coupler for Moisture Measurement of Oil Palm Fruits" 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 the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory 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 concurrently submitted for any other degree at UPM or other institutions.

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LEE KIM YEE

Date:

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