EFFECT OF TREATMENT VARIABLES ON THE SUPER-FAST DRYING METHOD ON THE PROPERTIES OF DRIED LOW-DENSITY OIL PALM LUMBER (OPL)

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EFFECT OF TREATMENT VARIABLES ON THE SUPER-FAST DRYING METHOD ON THE PROPERTIES OF DRIED LOW-DENSITY OIL PALM LUMBER (OPL)

By

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A Project Report Submitted in Partial Fulfilment of the of the Requirement for the Degree of Bachelor of Wood Science and Technology in the Faculty of Forestry

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DEDICATION

Special dedicate to my parents,

Chen Chee Kong and Quik Soi Moi.

My Grandmother, Yap Kwai Ying.

My sisters, Chen Bao Shian and Chen Yieng Wah.

All my beloved course mates and friends.

Thanks for all of your supports.

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ABSTRACT

"Super-Fast Drying" is a new oil palm wood (OPW) drying method which include drilling holes and hot pressing. From previous study, this technique could increase the drying rate of OPW with least defects. However, the method is still in preliminary phase. In this study, the best holing parameter for the low-density OPW (core of oil palm trunk) were verified. OPW were cut in the size of 300 x 50 x 20 mm, followed by holes drilling with the distance of 1.0 and 1.5 inch and hole diameter of 5, 7 and 9 mm. The specimen were hot pressed and oven dried. Mechanical and physical testing were carried out to determine the optimum parameters that show the best properties of super-fast dried OPW. From the findings, hole diameter results to significant effect on the properties, while hole distance does not. The optimum hole distance and hole diameter are 1.5 inch and 7mm, respectively.

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ABSTRAK

"Super-Fast Drying" adalah kaedah baru untuk pengeringan kayu kelapa sawit (OPW) termasuk berlubang dan tekanan panas. Daripada kajian sebelumnya, teknik ini boleh meningkatkan kadar pengeringan OPW dengan kecacatan yang kurang. Walau bagaimanapun, kaedah ini masih dalam fasa awal. Dalam kajian ini, parameter berlubang yang terbaik bagi OPW berketumpatan rendah (teras batang kelapa sawit) telah dipilih. OPW dipotong dalam saiz 300 x 50 x 20 mm, diikuti oleh lubang penggerudian dengan jarak 1.0 dan 1.5 inci dan diameter lubang 5, 7 dan 9 mm. Spesimen telah panas ditekan dan ketuhar kering. Ujian mekanikal dan fizikal telah dijalankan untuk menentukan parameter optimum yang menunjukkan ciri-ciri terbaik OPW Super-Fast Drying. Dari hasil kajian, diameter lubang memberi kesan yang besar kepada ciri-ciri, manakala jarak lubang tidak. Jarak lubang yang optimum adalah 1.5 inci dan 7mm.

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APPROVAL SHEET

Name of Candidate : Chen Yuen Ling

Title of Thesis : Effect of Treatment Variable on the Super-Fast Drying Method on the Properties of Dried Low Density Oil Palm Lumber (OPL)

I certify that this research project report entitled "**Effect of Treatment Variable on the Super-Fast Drying Method on The Properties of Dried Low Density Oil Palm Lumber (OPL)**" has been examined and approved as a partial fulfillment for the degree of Bachelor of Wood Science and Technology in the Faculty of Forestry, University Putra Malaysia.

…….

Assoc. Prof Dr. Edi Suhaimi Bakar
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……...

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Date: Jan 2017

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LIST OF ABBREVIATION

ANOVA	Analysis of Variance
CPO	Crude Palm Oil
MC	Moisture Content
MOE	Modulus of Elasticity
MOR	Modulus of Rupture
OPT	Oil Palm Trunk
OPW	Oil Palm Wood
PF	Phenol Formaldehyde
PKO	Palm Kernel Oil
SEM	Scanning Electron Microscopy
sMOE	Specific Modulus of Elasticity
sMOR	Specific Modulus of Rupture

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CHAPTER 1

INTRODUCTION

1.1 Background

Malaysia is located near the equator (khatulistiwa) and is categorised as equatorial climate. Throughout the year, Malaysia is hot (average 27°C), has high humidity (around 70%) and the average rainfall is 250 centimetres per year (Jamaluddin, 2012). This climate is very suitable for oil palm (*Elais guineensis Jacq*) plantation. Besides, Colchester et al. (2006) stated that South East Asia including Malaysia attracted many oil palm developers was because the lower labour cost, lower land rent, government plan to grow this sector, financial incentives and favourable climate. These led Malaysia and Indonesia, the main producers now, contributed more than 85% of total 33.7 million tonnes world production (Mielke, 2006).

Oil plant is mainly grown for oil production. The crude palm oil (CPO) and palm kernel oil (PKO) can be obtained from the fruits. It can be used to produce the products such as cooking oil and margarine. While PKO used to produce non-food products such as soaps, detergents, toiletries, cosmetic and candles. Nevertheless, palm oil only about 10% of the whole palm tree, while the other 90% remains biomass which full of fiber and cellulose (Thiam & Bhatia, 2008).

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The economic life of oil palm tree is about 25 years, it have to be replanted due to low fruit production or too tall for harvesting the fruits. Many replanting method had been developed the for example the “push-felled, chip & windrow” and “under-planting” method was being used after the zero burning program was introduced in 90’s (Erwinsyah, 2008). Nonetheless, these methods will lead to Ganoderma disease due to rats doing nest at the replanting area (Erwinsyah, 2008).

Finding an appropriate method for replanting the oil palm is essential, however we should also look for possibility of utilise this agriculture waste. Converting the oil palm stem into value added products such as alternative for solid wood could also helped the industries to earn more money from the wastage and reduce pollution to the environment. Many researchers in Malaysia and Indonesia have started doing research on this nowadays. This is because Malaysia and many other countries are facing problems of wood supply for wood industry. Therefore, many efforts have been done in order to utilise the oil palm biomass as a substitution for wood.

However, solid OPW has very low properties as shown in Table 1.1. As compared to wood, OPW has high moisture content. The moisture of a freshly felled OPT is high up to 200% - 500% (Kilmann and Lim, 1985), while normal wood only have less than 100% moisture content. Moreover, OPW has very high variation of density within a same stem. Thus, the drying process of OPW is problematic and

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critical before it turned into a value added product. This is because it might causes the drying defects like warping, twisting and honey combing, higher drying cost and took longer time. These are the reason why many wood industries refuse to use OPW as their raw materials.

Properties	Rank
Strength	5 out of 5
Durability	5 out of 5
Dimensional Stability	Very unstable
Machining Characteristic	5 out of 5

Table 1.1: Properties of Solid Oil Palm Wood (Source: Bakar, 2016)

Many scientists had done the research on OPW properties enhancement and creating suitable drying schedules for OPW. “Super-fast drying method” recently has been developed by Bakar et al. (2016). This method only require 3 hours to dry the OPW with minimum defects. It has 2-step drying, which are contact drying and high temperature drying on a OPT with holes. However, more studies are needed to check for its accessibility to the market.

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1.2 Problem Statement

As “Super-fast drying method” is a new method for OPW treatment, this research is still in the preliminary phase. Some of the drying parameters have not been optimised to produce the high performance treated OPW.

1.3 Justification

Super-fast Dried oil palm samples are drilled with holes, it might affect the mechanical properties and affect it physical properties. So in this research, the modulus of elasticity (MOE), modulus of rupture (MOR), water absorption (WA) and dimensional stability will be determined as the indicator for choosing the best parameters. Besides, the decay test of super-fast dried will be done to see how holing and hot-pressed affect its durability.

1.4 Objective

1.4.1 General Objective

To optimise drying parameters of Super-fast Drying method for low-density OPL.

1.4.2 Specific Objective

- To determine effect of hole distance on Super-fast Dried low-density OPW.
- To determine effect of hole diameter on Super-fast Dried low-density OPW.

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REFERENCES

Amin, Y., Dwianto, W., Prianto, A.H. Mechanical Properties of Compression Wood. *Proceeding of National Seminar of MAPEKI VII*. Makasar, Indonesia, 2004, pp.90 - 95.

Anonymous. Project Penyelidikan dan Penbangunan Bahan Binaan Alternatif Daripad Sisa Pertanian – Batang Kepala Sawait. *Laporan Akhir*. University Malaya & Institut Penyelidikan Perhutanan Malaysia, 2002, pp. 175.

Anthony, A. The Oil Palm Tree. Malaysia Palm Oil Council (MPOC), 2013, retrieved from *http://www.mpoc.org.my/The_Oil_Palm_Tree.aspx*. Accessed on: May 2016.

Bakar, E.S., Hermawan, D., Karlina, S., Rachman, O., Rosdiana, N. Utilization of oil-palm trees as building and furniture materials (I): Physical and chemical properties, and durability of oil-palm wood. Jurnal Teknologi Hasil Hutan, vol. 11, no. 1, 1998, pp. 1–12.

Bakar, E. S., Rachman, O., Hermawan, D., Karlinasari, L., & Rosdiana, N. "Utilization of oil palm trees as building and furniture materials (1): Physical and chemical properties and durability of oil palm trunk," *Journal of Forest Products Technology*, vol. 11, no.1, 1998, pp. 1-12.

Bakar, E. S., Febrianto, F., Wahyudi, I., & Ashaari, Z. Polygon Sawing: An Optimum Sawing Pattern for Oil Palm Stems. *Journal of Biological Science*, vol. 6, no. 4, 2006, pp. 744–749.

Bakar, Edi Suhaimi, Abare, Al-Hasan Yakubu, Yong, Adrain C. C. and Ashaari, Zaidon. New efficient, practical method for producing 'Compreg' OPW through integrated objective approach. University Putra Malaysia, 2014.

© COPYRIGHT UPM

Bakar, E. S., Soltani, M., Paridah, M. T. and Choo, S. C. Y. Super-Fast Drying Method for Oil Palm Lumber. *Pameran Rekacipta, Penyelidikan dan Inovasi,* 2016.

Bakar, E. S. “Case Study of OPW”, Faculty of Forestry University Putra Malaysia, May 2016.

Bekhta P, Hiziroglu S & Shepelyuk O. Properties of Plywood manufactured from compressed veneer as building material. *Material and Design*, vol. 30, 2009, pp. 947-953.

Candan Z, Hiziroglu S and McDonald AG. Surface quality of thermally compressed Douglas fir veneer. *Material and Design* vol. 31, 2010, pp. 3574-3577.

Cech, M. Dynamic transverse compression treatment to improve drying behaviour of yellow birch. *Forest Prod. J*, vol. 21, no.2, 1971, pp. 41-50.

Chave, J., Coomes, D., Jansen, S., Lewis, S.L., Swenson, N.G. and Zanne, A.E. Towards a worldwide wood economics spectrum. *Ecology Letters*, vol. 12, 2009, pp. 351–366.

Choon, K. K., Killmann, W., Choon, L.S. and Mansor, H. “Characteristics of the oil palm stem,” *Oil Plam Stem Utilization*, Forest Research Institute Malaysia, Kuala Lumpur, Malaysia, 1991, pp. 15-28.

Chundoff, M. Void volume wood: An any tree-whole tree use concept. *Forest Prod. J*, vol. 22, no. 6, 1972, pp. 49-53.

Colchester, M., Jiwan, N., Andiko, Sirait, M. T., Firdaus, A. Y., Surambo, A. and Pane, H. Promised Land: Palm Oil and Land Acquisition in Indonesia - Implications for Local Communities and Indogenous Peoples. Forest People Programme (FPP), Sawit Watch, HUMA and World Agroforestry Center (ICRAF), SEA Regional Office, 2006.

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Corley, R. H. V. & Tinker, P. B. The Oil Palm Fourth Edition. Blackwell Science, 2003, pp. 1 -18.

Erickson, R., and Demarel, L. The drying of predrilled aspen lumber. *Forest Prod. J,* vol. 22, no. 11, 1972, pp. 48-50.

Erwinsyah. Improvement of Oil Palm Wood Properties Using Bioresin. *Technische Universitat Dresden*, 2008.

Halimahton. M. and Ahmad, A. R. Carbohydrates in the oil palm stem and their potensial use. *Journal of Tropical Forest Science*, vol. 2, no. 3, 1990, pp. 220–226.

Jamaluddin, A. F. The Weather and Climate of Malaysia. Malaysia Meteological Department Ministry of Science, Technology and Innovation, 2012.

Jumaat MZ, Rahim AHA, Othman J and Midon MS. Strength evaluation of oil palm stem trussed rafters. *Construction and Building Materials* vol. 20, 2006, pp. 812-818.

Khoo, K.C., Killmann, W., Lim, S.C. and Halimahton,M. Characteristics of the Oil Palm Stem. *Oil Palm Stem Utilisation – Review of research, Research Pamplet No. 107*, FRIM, 1991.

Killmann, W., and Lim, S.C. Anatomy and properties of oil palm stem. *Processing of the National Symposium on Oil Palm By-Products for Agro Based Industries*, 1985, pp. 13-42.

Laemsak, N., and Okuma, M. Development of boards made frim oil palm frond Ih properties of binderless boards from steam exploded fibers of oil palm frond. *J. Wood Sci.* vol. 46, 2000, pp. 322-326.

Larjavaara, M., Muller-Landau, H. C. Rethinking the Value wood high Wood. *British Ecology Society*, 2010.

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Lim, S.C. and Khoo, K.C. Characteristic of oil palm trunk and its potential utilization. *The Malaysian Forester*, vol. 49, no. 1, 1986, pp. 3-22.

Mielke, T. Oil world data base, 2006. *www.oilworld.biz*, accessed in June 2016.

Murai, K., Uchida, R., Okubo, A., and Kondo, R. Characterization of the oil palm trunk as a material for bioethanol production. *Mokuzai Gakkashi*, vol. 55, 2009, pp. 346-355.

Othman, K., Yamani, S. A. K., Sahat, S., Shafie, A., Junaiza, A. Z., Latif, N. H., Aminudin, M., Hazlan, N. H. and Norashikin, K. Study on Drying of Oil Palm Trunk with Ethanol. *KONAKA 2013*, 2013.

Prayitno, T. A. Trunk shape and physical properties of oil palm trunk. *Buletin Fak. Kehutanan* UGM, Yogyakarta, Indonesia, vol. 29, 1995, pp. 43–59.

Sudin, R., Ali, A. R. M. and Mohd.Amin, Z. Chemical components in oil palm trunk influencing wood-cementboard manufacture. Technical report, Asian Science and Technology Congress, Kuala Lumpur, 1987.

Rafidah, J., Asma, W., Puad, E., Mahanim, S. M. A., and Shaharuddin, H. Toward zero waste production of value added products from waste oil palm trunk (WOPT). Forest Research Institute Malaysia (FRIM), Malaysia, 2012.

Rudi, H., Wahyudi, I., Febrianto, F., Dwianto, W., Hidayat, W., Jang, J. H., Lee, S. H., Park, S.H. and Kim, N. Quality Improvement if Oil Palm Trunk Properties by Close System Compression Method. *Journal of the Korean Wood Science and Technology,* vol. 44, no. 2, 2016, pp. 172-183.

Schwarz, H. G. Cement-bonded boards in Malaysia. Fibre and Particleboards Bonded with Inorganic Binders, Forest Products Research Soc.., Madison, WI, US, 1985, pp. 91-93.

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Sulaiman, O., Hashim, R., Raza, K. W., Hashim, W. S. and Azmy, M. Evaluation on some finishing properties of oil palm plywood. *Holz Roh Werkst*, vol. 66, 2008, pp. 5-10.

Sulaiman, O., Awalludin, M. H., Hashim, R., and Nadhari, W. N. A. W. An Overview of the Oil Palm Industry in Malaysia and its Waste Utilization through Thermochemical Conversion, Specifically via Liquefaction. *Renewable and Sustainable Energy Review,* 2015.

Sulistyono. Physical, Mechanical Properties, and Reliability Construction from Compressed Agathis Wood (Aghatis loranthifolia Salibs). Forestry Science Department. Postgraduate Program. Institut Pertanian Bogor, 2011.

Teck, C. L., and Ong, C. L. Particleboard from oil palm trunk. *PORIM Bulletin*, vol. 11, 1985, pp. 99-108.

Terazawa, S. and Tsutsumoto, T. Wood Drying. Tokyo, Japan: Wood Technological Association of Japan, 1976.

Thiam, L. C. and Bhatia, S. Catalytic Processes toward the Production of Biofuels in a Palm Oil and Oil Palm Biomass-Based Biorefinery. Universiti Sains Malaysia, Pulau Pinang, 2008.

Yuliansyah AT, Hirahima T, Kumagai S and Sasaki K. Production of solid biofuel from agricultural wastes of the palm oil industry by hydrothermal treatment. *Waste Biomass Valor*, vol 1, 2010, pp. 395-405.

William, T. S. Laser Incising to Increase Drying Rate of Wood. U.S. Department of Agriculture, Madison, 1985.

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