SUPER-FAST DRYING OF BLIND-HOLED OIL PALM LUMBER (OPL)

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FH 2018 58

SUPER-FAST DRYING OF BLIND-HOLED OIL PALM LUMBER (OPL)

By

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A Project Report Submitted in Partial Fulfillment of the Requirements for the Degree of Bachelor of Wood Science Technology in the Faculty of Forestry Universiti Putra Malaysia

2018

DEDICATION

Special dedicate to my parents,

Lim Tse An and Koo Fen Fang.

My brother, Lim Jun Xian and Lim Jun Xuan.

All my beloved course mates and friends.

Thank you for all of your supports.

ABSTRACT

"Super-Fast Drying" method is a newly invented method to dry oil palm wood (OPW). This method involves drilling holes and hot pressing. From the previous study, this method could increase the drying rate of OPW with minimal defects. However, the holing appearance had limited the application of OPW in the industry. In this study, blind holing is introduced with the best holing parameter for both peripheral and core of oil palm trunk were verified. The sample size for core of OPT is cut in the size of (200 x 50 x 18) mm whereas the sample size for peripheral of OPT is (300 x 50 x 18) mm, followed by holes drilling with the depth of $\frac{1}{3}$, $\frac{1}{2}$ and $\frac{2}{3}$ hole diameter of 5,7 and 9-mm. The specimens were hot pressed and oven dried. Mechanical testing and physical testing were carried out on the sample size with 4 replications. From the findings, both holes' diameters and holes' depths result to significant effect on the properties. The optimum holes' depth and holes' diameter are $\frac{1}{3}$ and 7-mm respectively

ABSTRAK

Kaedah “Super-Fast Drying” ialah kaedah baru dicipta pengeringan kayu kelapa sawit (OPW). Kaedah ini merangkumi lubang gerudi dan tekanan panas. Berdasarkan kajian sebelumnya, kaedah in dapat meningkatkan kadar pengeringan kayu kelapa sawit dengan karosakan yang minimum. Walau bagaimanapun, penampilan berlubang menghadkan penggunaan OPW dalam industri. Dalam kajian ini, “blind holing” telah diperkenalkan dengan parameter berlubang yang terbaik bagi OPW teras batang dan periferi batang OPW. Teras batang OPW telah dipotong dalam saiz (200 x 50 x 18) mm manakala periferi batang OPW dalam saiz (300 x 50 x 18) mm, diikuti dengan lubangan penggerudian dalam kedalaman $\frac{1}{3}$, $\frac{1}{2}$ and $\frac{2}{3}$ dan diameter lubangan of 5,7 and 9-mm. Spesimen melalui proses “hot press” dan ketuhar kering. Ujian mekanikal dan fizikal telah dijalankan pada 4 replikasi sample. Dari hasil kajian ini, kedua kedalaman lubangan dan diameter lubangan memberi kesan yang besar kepada ciri-ciri. Lubangan yang optimum adalah $\frac{1}{3}$ dan 7-mm.

ACKNOWLEDGEMENT

I wish to express my sincere gratitude to my supervisor Assoc. Prof. Dr. Edi Suhaimi Bakar for providing me an opportunity to do my final year project and also appreciate his guidance, motivation and financial support throughout this research. I sincerely thank Dr. Mojtaba Soltani for guidance and encouragement in carrying this project work.

Futhermore, I would like to thank my teammates, Chang Ying Ying, Chia Zi Bin, Wong Mui Leng, Mohd Rafsan Bin Rais and Muhammad Nadzim Bin Mohd Nazip who rendered their help during the period of my project work.

Lastly, I would like to thank my parents & friends and lab assistants, one and all who helped me to complete this project successfully.

APPROVAL SHEET

I certify that this research project report entitled "**Super-Fast Drying Of Blind-Holed Oil Palm Lumber"** has been examined and approved as a partial fulfillment for the degree of Bachelor of Wood Science and Technology in the Faculty of Forestry, Universiti Putra Malaysia.

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Date : Jan 2018

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LIST OF ABBREVIATION

CPO	crude palm oil
PKO	palm kernel oil
FFB	fresh fruit bunches
EFB	empty fruit brunch
OPF	oil palm fronds
PPF	palm pressed fiber
POME	palm oil mill effluent
OPSW	oil palm solid waste
MC	moisture content
OPL	oil palm lumber
OPT	oil palm trunk
MOE	modulus of elasticity
MOR	modulus of rupture
sMOE	specific modulus of elasticity
sMOR	specific modulus of rupture
ANOVA	analysis of variance

CHAPTER 1

INTRODUCTION

1.1 Background

According to Malaysian Palm Oil Board (MPOB), oil palm (*Elaeis huineensis*) was first introduced to Malaysia as a decorative plant in 1870. It is then planted rapidly in 1960 and achieved 1.5 million hectares of oil palm trees plantation area in the year 1985 (MPOB, 2011). In the mid-20th century, Malaysia had become the biggest palm oil producer in the world. However, this record has been overtaken by Indonesia in 2006 (MPOB, 2011). In 2016, according to the overview of MPOB, Malaysia achieved 5.74 million hectares of oil palm tree plantation while based on the data of Indonesian Palm Oil Producers Association (Gapki), there are estimated 11.8 million hectares of Indonesia land denoted to oil palm tree plantations (Indonesia Investment, 2017). These data have shown the development of palm oil industries in these two countries which has created one of the most successful stories in the history of the countries' agricultural sector.

The rapid growth in oil palm industry is mainly caused by the high demand for its products which is crude palm oil (CPO) and palm kernel oil (PKO) (Crabbe *et. al.*, 2001). The palm oil can be used to produce a huge variety of products especially in the food-related commodity such as cooking oil, margarine and etc. It can also use as the base for most liquid detergent, soap, and shampoos. Furthermore, it is extensively used in the cosmetic product.

Due to explosive development in palm oil industry, massive wastes are formed which include fresh fruit bunches (FFB), empty fruit brunch (EFB), oil palm fronds (OPF), palm pressed fiber (PPF), palm shells, palm oil mill effluent (POME), oil palm trunk (OPT) and etc (Embrandiri *et. al.*, 2012). These oil palm solid waste (OPSW) was formed during the tree replantation of its economic life spans. According to Erwinsyah (2008), oil palm tree reaches an average volume of 1.638m^3 after its economic live span which is between 25-32 years (Erwinsyah, 2008). After this period, most of the OPT are left at the plantation area to decompose as their economic values were low. It is estimated that about 20million m^3 of OPT were felled annually in Malaysia for replanting of new trees. Therefore, Indonesia and Malaysia have been concerning on the utilization of oil palm wastes over the last decade. Unfortunately, the information and knowledge about OPT are still limited.

To overcome the issues of OPSW, a lot of researches have been carried out from all over the globe. Among all the research, the intensive research is the utilization of the OPT. This is because the shortage of solid wood raw material has forced wood-based industries to find an alternative substitution for wood raw material. Furthermore, OPT is low cost, low density, safe to be handled, renewable, economically feasible and biodegradable as compared with the ordinary lumber in the market (Dungani *et. al.*, 2013). However, most of the wood manufacturers are still refuse to use OPT as raw material because it has several inherent flaws as compared to the ordinary lumber. The OPT has inconsistent weight, high moisture content (MC), high variation of density, and

high percentages of parenchyma tissues (Mokhtar *et. al.*, 2011). These properties might cause several wood drying defects such as twisting, warping and at the same time will also increase the cost of processing and manufacturing time.

These defects can be minimized by using the proper drying methods and drying conditions. Recently, there are several new improved drying technologies had been offered to produce high recovery and improved quality oil palm lumber (OPL) and also to create suitable drying schedules for OPL. “Super-fast drying” method is one of the advanced technology that been developed by Bakar *et. al.* (2016) . This method only requires 3 hours of drying process to dry OPL with minimal defects. It involved 2-step drying, which included hot plates contact drying to certain MC and high-temperature kiln drying to a targeted MC. This method is capable to dry high and low-density OPL. There are holes in the OPL samples to ease and speed up the drying process. However, the holes on the OPL have limited its application and hardly accessible to the market. Thus, this study is conducted to form blind-holed OPL where holes are drilled to a certain depth of the sample. Blind-holed forming is known as samples which have 1 sided surface with holes and another surface without holes (clear surface). Physical and mechanical properties of the blind-hole OPL were determined in this study. A better understanding and improvement of this study will help to develop economic uses for OPL and reduce the need for disposal and environmental deterioration such as pollution, forest fire, etc.

1.2 Problem Statement

According to the previous study of “super-fast drying” method, researchers found out that it is impractical to eliminate the holing process from the “super-fast drying” method. However, the dried OPL has very limited applications without removing the holes due to its holing appearance. Therefore, the blind-holed super-fast drying method is introduced in this study to form only one-sided clear surface OPL. This is to increase the potential of OPL to be used in various applications without affecting its properties as full holing dried OPL.

1.3 Justification

“Super-fast drying” method involves holes forming on the OPL samples which might affect the mechanical properties and physical properties. In this study, different depth and diameter of holes will be formed to determine the best parameters. This research will be focusing on determining the modulus of elasticity (MOE), modulus of rupture (MOR), water absorption and thickness swelling as the indicator for choosing best parameter.

1.4 Objective

1.4.1 General Objective

To identify the effect of holing parameters on the performance of super-fast drying oil palm lumber (OPL).

1.4.2 Specific Objectives:

1. To identify the effect of holing depth on the mechanical properties of super-fast dried oil palm lumber
2. To identify the effect of holing depth on the physical properties of super-fast dried oil palm lumber

REFERENCE

A. N. Haslett. (1990). Suitability of oil palm trunk for timber uses. *Journal of Tropical Forest Science*, *vol.2*, 243–251. Retrieved from http://www.jstor.org/stable/43594337

Abdullah, N., & Sulaim, F. (2013). The Oil Palm Wastes in Malaysia. In *Biomass Now - Sustainable Growth and Use*. https://doi.org/10.5772/55302

Ahmad, N., Kasim, J., Mahmud, S. Z., Yamani, S. A. K., Mokhtar, A., & Yunus, N. Y. M. (2011). Manufacture and properties of oil palm trunk particleboard. In *3rd ISESEE 2011 - International Symposium and Exhibition in Sustainable Energy and Environment* (pp. 84–87). https://doi.org/10.1109/ISESEE.2011.5977115

Ahmad, Z., Saman, H. M., & Tahir, P. M. (2010). Oil palm trunk fiber as a bio-waste resource for concrete reinforcement. *International Journal of Mechanical and Materials Engineering*, *5*(2), 199–207.

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

Bakar, E. S., Febrianto, F., Wahyudi, I., & Ashaari, Z. (2006). Polygon sawing: An optimum sawing pattern for oil palm stems. *Journal of Biological Sciences*, *6*(4), 744–749. https://doi.org/10.3923/jbs.2006.744.749

Bakar, E. S., Hermawan, D., Karlina, S. (Institut P. B. (Indonesia), Rachman, O., & Rosdiana, N. (1998). Pemanfaatan batang kelapa sawit (Elaeis guineensis Jacq.) sebagai bahan bangunan dan furniture (I): sifat fisis, kimia dan keawetan alami kayu kelapa sawit 1). *Jurnal Teknologi Hasil Hutan (Indonesia)*.

Basiron, Y. (2007). Palm oil production through sustainable plantations. *European Journal of Lipid Science and Technology*, *109*(4), 289–295. https://doi.org/10.1002/ejlt.200600223

Crabbe, E., Nolasco-Hipolito, C., Kobayashi, G., Sonomoto, K., & Ishizaki, A. (2001). Biodiesel production from crude palm oil and evaluation of butanol extraction and fuel properties. *Process Biochemistry*, *37*(1), 65–71. https://doi.org/10.1016/S0032-9592(01)00178-9

Dungani, R., Jawaid, M., Khalil, H. P. S. A., Jasni, Aprilia, S., Hakeem, K. R., … Islam, M. N. (2013). A review on quality enhancement of oil palm trunk waste by resin impregnation: Future materials. *BioResources*, *8*(2), 3136–3156.

Embrandiri, A., Singh, R. P., Ibrahim, H. M., & Ramli, A. A. (2012). Land application of biomass residue generated from palm oil processing: Its potential benefits and threats. *Environmentalist*, *32*(1), 111–117. https://doi.org/10.1007/s10669-011-9367-0

Erwinsyah. (2008). Improvement of Oil Palm Wood Properties Using Bioresin. Retrieved from http://www.qucosa.de/fileadmin/data/qucosa/documents/608/1211880694953-3697.pdf

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

Lai, O.-M., Tan, C.-P., & Akoh, C. C. (2015). *Palm Oil: Production, Processing, Characterization, and Uses*.

Lamaming, J., Hashim, R., Leh, C. P., Sulaiman, O., & Sugimoto, T. (2014). Chemical , Crystallinity and Morphological Properties of Oil Palm Trunk Parenchyma and Vascular Bundle. *Bio-Technology and Environmental Engineering*, (January), 68–72.

Lim, S. C., & Gan, K. S. (2005). TIMBER TECHNOLOGY Characteristics and utilisation of oil palm stem. *Timber Technology Bulletin*, (35), 1–12.

Lim, S. C., & Khoo, K. C. (1986). Characteristics of oil palm trunk and its utilization. *Malaysian Forester*, *49*(1–2), 3–22.

Mokhtar, A., Hassan, K., Aziz, A. A., & Wahid, M. B. (2011). Plywood from oil palm trunks. *Journal of Oil Palm Research*, *23*(DECEMBER), 1159–1165.

MPOB. (2011). OIL PALM IN MALAYSIA. Retrieved May 1, 2017, from http://www.palmoilworld.org/about_malaysian-industry.html

MPOC. (n.d.). The Oil Palm Tree. Retrieved from http://www.mpoc.org.my/The_Oil_Palm_Tree.aspx

Murai Kyushu Univ., Fukuoka (Japan), K., Uchida, R., Okubo, A., & Kondo, R.

(n.d.). Characterization of the oil palm [Elaeis guineensis] trunk as a material for bio-ethanol production. *Journal of the Japan Wood Research Society (Japan)*.

Obahiagbon, F. I. (2012). A review: Aspects of the African oil Palm (Elaeis guineesis jacq.) and the implications of its bioactives in human health. *American Journal of Biochemistry and Molecular Biology*. https://doi.org/10.39231ajbmb.2012.106.11

Palm Oil. (2017). Retrieved May 1, 2017, from https://www.indonesia-investments.com/business/commodities/palm-oil/item166

Sulaiman, O., Salim, N., Hashim, R., Yusof, L. H. M., Razak, W., Yunus, N. Y. M., Azmy, M. H. (2009). Evaluation on the suitability of some adhesives for laminated veneer lumber from oil palm trunks. *Materials and Design*, *30*(9), 3572–3580. https://doi.org/10.1016/j.matdes.2009.02.027

Sulaiman, O., Salim, N., Nordin, N. A., Hashim, R., Ibrahim, M., & Sato, M. (2012). The Potential Of Oil Palm Trunk Biomass as an Althernative Source For Compressed Wood. *7*, 2688–2706. https://doi.org/10.15376/biores.7.2.2688-2706

Sumathi, S., Chai, S. P., & Mohamed, A. R. (2008). Utilization of oil palm as a source of renewable energy in Malaysia. *Renewable and Sustainable Energy Reviews*. https://doi.org/10.1016/j.rser.2007.06.006

Surip, S. N., Bonnia, N. N., Anuar, H., Hassan, N. A., & Yusof, N. M. (2012). Nanofibers from oil palm trunk (OPT): Preparation & chemical analysis. In *ISBEIA 2012 - IEEE Symposium on Business, Engineering and Industrial Applications* (pp. 809–812). https://doi.org/10.1109/ISBEIA.2012.6423003

Tan, K. T., Lee, K. T., Mohamed, A. R., & Bhatia, S. (2009). Palm oil: Addressing issues and towards sustainable development. *Renewable and Sustainable Energy Reviews*, *13*(2), 420–427. https://doi.org/10.1016/j.rser.2007.10.001

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