PROPERTIES ASSESSMENT OF LAMINATED OIL PALM LUMBER MADE FROM SUPER FAST DRIED OIL PALM WOOD BONDED WITH DIFFERENT ADHESIVE TYPE AND HOLING ALIGNMENT

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By

RUSLAN BIN MOHD NASIR

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DEDICATION

Every challenging work needs self-efforts as well as guidance of elders especially those who were very close to our heart.

My humble effort I dedicate to my sweet and loving

Family Members

Whose affection, love and encouragement make me able to get such success and honor

Along with all helpful and respected

Lecturers & Staffs

ABSTRACT

Malaysia is the largest producer of palm oil in the world and through this activity, it produces huge amount of unutilized Oil palm trunk (OPT). Decreasing of raw material from forest production land, non-wood such as oil palm has become the important alternative raw material. So in this research, OPT is used as an alternative material for wood composite product. After that, the super-fast drying method that has been introduced by Bakar et al. in 2016 can improve the efficiency of drying, and minimize the drying defects. This study was undertaken to determine the gluing condition, holes position and physio-mechanical properties of laminated super-fast dried oil palm lumber. In this study, two different types of adhesive and holes position have been used for produce laminated super-fast dried oil palm lumber. The results revealed that laminated super-fast dried oil palm lumber with optimum physical (thickness swelling and water absorption) and mechanical properties (bending properties and shear strength) was produced using different adhesive and holes position.

ABSTRAK

Malaysia adalah pengeluar minyak sawit terbesar di dunia dan melalui aktiviti ini, ia menghasilkan sejumlah besar batang kelapa sawit yang tidak digunakan (OPT). Pengurangan bahan mentah dari tanah pengeluaran hutan, hasil hutan bukan kayu seperti kelapa sawit menjadi bahan mentah alternatif yang penting. Jadi dalam kajian ini, OPT digunakan sebagai bahan alternatif untuk produk komposit kayu. Selepas itu, kaedah pengeringan 'super-fast dried' yang telah diperkenalkan oleh Bakar et al. pada tahun 2016 dapat meningkatkan kecekapan pengeringan, dan meminimalkan cacat pengeringan. Kajian ini dijalankan untuk menentukan keadaan pelekat, kedudukan lubang dan sifat-sifat fisiologi mekanik kayu kelapa sawit yang dikeringkan dengan kaedah pengeringan 'super-fast dried'. Dalam kajian ini, dua jenis pelekat dan lubang berlainan digunakan kepada 'super-fast dried' papan kelapa sawit berlamina. Hasil kajian membuktikan bahawa 'super-fast dried' papan lamina kelapa sawit dengan fizikal optimum (bengkak tebal dan penyerapan air) dan sifat mekanikal (sifat lenturan dan kekuatan ricih) telah dihasilkan menggunakan pelekat dan kedudukan lubang berlainan.

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APPROVAL SHEET

I certify that this research project entitled “Properties Assessment of Laminated Oil Palm Lumber Made from Super-Fast Dried Oil Palm Wood Bonded with Different Adhesive Type and Holing Alignment” by Ruslan bin Mohd Nasir has been examined and approved as a partial fulfillment of the requirement for the degree of Bachelor of Wood Science and Technology in the Faculty of Forestry, Universiti Putra Malaysia.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

CPO	Crude Palm Oil
MC	Moisture Content
MOE	Moistures of Elasticity
MOR	Modulus of Rupture
OPT	Oil Palm Trunk
OPW	Oil Palm Wood
PF	Phenol Formaldehyde
PVAc	Polyvinyl acetate
PRF	Phenol-resorcinol-formaldehyde
PKO	Palm Kernel Oil
sMOE	Specific Modulus of Elasticity
sMOR	Specific Modulus of Rupture
SPSS	Statistical Package for Social Science
SWP	Solid wood panel
TS	Thickness Swelling
WA	Water Absorption

CHAPTER 1

INTRODUCTION

1.1 Background of Study

The past few decades have seen the rapid growth of the oil palm industry in Malaysia, in terms of cultivated area and volume of production. Today, oil palm dominates the landscape throughout the country and the industry has become a major contributor to Malaysia's export earnings. Malaysia is currently the world's largest exporter of palm oil although it is the second-largest producer of the oil after neighboring Indonesia. Malaysia is located near the equator and is categorized as equatorial climate. Throughout the year, Malaysia is hot (average 27°C), has high humidity (around 70%) and the average rainfall is 250 centimeters 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 because lower labor cost, lower land rent, in line with government plan (to grow this sector), financial incentives and favorable climate.

Today, 5.7 million hectares of land in Malaysia is under oil palm cultivation, producing 17.73 million tons of palm oil and 2.13 tons of palm kernel oil. Malaysia is one the largest producers and exporters of palm oil in the world, accounting for 11% of the world's oils & fats production and 27% of export trade of oils & fats. The industry provides employment to more than half a million people and livelihood to an estimated one million people.

Oil palm is a monocotyledon crop as it bears both male and female flowers on the same tree. Each tree produces compact bunches weighing between 10 and 25 kilograms with 1000 to 3000 fruitlets per bunch. Each fruitlet is almost spherical or elongated in shape. Generally, the fruitlet is dark purple, almost black and the color turns to orange red when ripe. Each fruitlet consists of a hard kernel (seed) enclosed in a shell (endocarp) which is surrounded by a fleshy mesocarp.

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).

To overcome the issues of OPW, 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 oil palm trunk (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.

These properties might cause several wood drying defects such as twisting, warping and at the same time will increase the cost of processing and manufacturing time.

The drying 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 three hours of drying process to dry 3mm OPL with minimal defects. It involved two-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 both high-density 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 will limit its application and therefore difficult to penetrate the market. Thus, this study was to develop and asses the properties of laminated OPL from blind-holed super-fast dried OPL. Blind-holed super-fast dried OPL samples, which have one surface with holes and another surface without holes (clear surface).

Then, 2 pieces blind holed OPL are laminated with holed surface are facing to each and other. Physical and mechanical properties of the laminated 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, and others.

1.2 Problem Statement and Justification

Malaysia is the largest producer of palm oil in the world and through this activity, it produces huge amount of unutilized Oil palm trunk (OPT). Decreasing of raw material from forest production land, non-wood such as oil palm has become the important alternative raw material. So in this research, OPT is used as an alternative material for wood composite product. Other than that, wastage of natural resources also can be prevented. After that, the super-fast drying method that has been introduced by Bakar et al. in 2016 can improve the efficiency of drying, and minimize the drying defects. However, this super-fast dried lumber has its limitation which is the poor appearance of the holing surface which is not pleasant to be a final product. Therefore, the surface of the superfast dried lumber should be embellished for commercialization. Laminated board is one of the solutions to solve the poor appearance of holing surface, where two pieces of super-fast oil palm lumber (OPL) is bind together with thermoplastic with the holed surfaces are facing to each and other to form two layers of laminates.

1.3 Objectives

1.3.1 General Objective

To produce high performance Laminated Super-fast dried OPL for wood alternative.

1.3.2 Specific Objectives

1. To evaluate effect of holing alignment on the physical and mechanical properties of laminated super-fast dried OPL from different part of OPT.
2. To evaluate the effect of glue type on the physical and mechanical properties of laminated super-fast dried OPL from different part of OPT.

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