PHYSICO–MECHANICAL PROPERTIES OF SESENDUK AT 12% INITIAL MOISTURE CONTENT TREATED WITH DIRECT CONTACT HEAT TREATMENT METHOD

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By

MUHAMAD FAIZ BIN MOHD FAUZI

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DEDICATION

This thesis is dedicated to:

My parents,

Mohd Fauzi Bin Mohd Fauzi

Mazizah Binti Ahmad

My supervisor,

Assoc. Prof. Dr. Edi Suhaimi Bakar

And all of my friends.

Thank you for being there during my ups and downs.

ABSTRACT

Under-utilized species such as Sesenduk have a high potential to be an alternative to substitute wood as a raw material. This study describes the effects of thermal modification with direct contact of heat treatment method on physical and mechanical properties of Sesenduk wood at different level of thickness, temperature and time. Samples of Sesenduk *wood* (80mm x 320mm) with the thickness of 1cm, 1.5cm and 2cm were heat-treated at 160^0C, 180^0C and 200^0C with 15 minutes, 30 minutes and 45 minutes. The physical properties were determined by water absorption and volumetric swelling tests. The mechanical properties were determined by 3 points static bending tests. The result showed that the thickness and the level of temperature affected significantly on water absorption and volumetric swelling while the length of exposure did not influence the physical properties. The values for MOR had significantly affected by the different level of temperature and the values of MOE had significantly affected by thickness and duration of time. The visual color changes were more distinct after heat treatment above 180^0C and the time of 45 minutes. Temperature had a greater influence than time on these properties of samples.

ABSTRAK

Spesis yang kurang digunakan seperti Sesenduk mempunyai potensi yang tinggi untuk menjadi alternatif untuk menggantikan kayu sebagai bahan mentah. Kajian ini menerangkan kesan pengubahsuaian haba dengan hubungan secara langsung kaedah rawatan haba ke atas sifat-sifat fizikal dan mekanikal kayu sesenduk di peringkat yang berbeza pada ketebalan, suhu dan masa. Sampel Sesenduk kayu (80mm x 320mm) dengan ketebalan 1cm, 1.5cm dan 2cm telah dirawat menggunakan haba pada 160^0C, 180^0C dan 200^0C selama 15 minit, 30 minit dan 45 minit. Ciri-ciri fizikal ditentukan oleh penyerapan air dan ujian perubahan isipadu. Sifat-sifat mekanikal ditentukan melalui ujian lenturan statik. Hasilnya menunjukkan bahawa ketebalan dan tahap suhu terjejas dengan ketara pada penyerapan air dan perubahan isipadu manakala panjang pendedahan ini tidak mempengaruhi sifat-sifat fizikal. Nilai untuk MOR telah terjejas dengan ketara pada tahap suhu yang berbeza dan nilai-nilai MOE telah dipengaruhi oleh ketebalan dan tempoh masa. Perubahan warna visual lebih jelas selepas rawatan haba di atas 1800C dan masa 45 minit. Suhu mempunyai pengaruh yang lebih besar daripada masa pada sifat-sifat ini spesimen.

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APPROVAL SHEET

I certify that this research project report entitled **"Physico–Mechanical Properties Of Sesenduk At 12% Initial Moisture Content Treated With Direct Contact Heat Treatment Method"** by **Muhamad Faiz Bin Mohd Fauzi** has been examined and approved as a partial fulfillment of the requirements for the degree of Bachelor ofWood Science Technology in the Faculty of Forestry, Universiti Putra Malaysia.

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FRIM	Forest Research Institute Malaysia
SEM	Scanning Electron Microscopy
SPSS	Statistical Product and Service Solutions
ANOVA	Analysis of Variance
MOR	Modulus of Rupture
MOE	Modulus of Elasticity
VC	Volumetric Change
WA	Water Absorbtion
CC	Colour Change

CHAPTER 1

INTRODUCTION

1.1 Background

Population trends are one of the key that related closely to the development growth in the world. Over the past 50 years, the world has experienced a significant increase in population world previous study has been reported that, world's populations are expected to be increase around 10 billion by year of 2050 (Steck, 2014). These situations give a huge implication to the dramatic increase of global demand for timber product. As a result, the depleting supply of high quality known timbers especially from natural and plantation forest in Malaysia (Rabi'atul et al., 2012).

Therefore, many manufacturers started to seek an alternative as a substitution of new material. Several studies has been carried out and reports that there are many other timber species which has been fully explored because of their poor inherent properties and among of these species is the low density wood species such as *Endospermum diadenum* (Sesenduk) (Rabi'atul et al., 2012; Ashaari et al., 2010). This species has a great potential to become a high value-added of timber if it properties can be improved. A series of work has been conducted to enhance the properties of this species such as the modification of wood by impregnation with suitable polymer (Hill 2006), chemical modification using bulking treatment, internal coating and cross linking (Chang and Chang 2002, Rowel 2005, Ashaari *et al.,* 2010) and these methods has successfully improve the dimensional stability and strength of this material. However, there are several drawbacks that occurred such as a release of formaldehyde emission and an increasing cost of processing material. New method has been introduced recently by using a thermal modification of wood with direct contact of heat treatment method. Callum Hill (n.a) stated that wood modification involves the action of chemical, biological, or physical agent upon the material resulting in desired property enhancement during the service life of the modified wood. He also added that the modified wood should itself be non-toxic under service conditions and furthermore, there should be no release of any toxic substances during service, or at end of life following disposal or recycling of the modified wood. Furthermore, the demand for enviromental friendly wood products has increased and challenging the timber industry to supply markets with durable timber without using additional chemical (Anonymous, 2003). Therefore, its believed that by using a thermal modification of wood with direct contact of heat treatment method may produce a high quality of timber that is environmental friendly and become a high potential as a new material. A new efficient and practical method with Direct Contact Method has been developed by Mojtaba et al. (2015). This method is known as hygro-thermal modification because it uses steam as the media and is relatively easy to handle.

In this method, the temperature can be directly transferred to the wood veneer from the hot plate and improved the properties of the veneer.

1.2 Problem Statement

As time passes, many human activities involving forest area occurred such as deforestation, illegal logging and others. As the result of these irresponsible actions, the sustainability of the wood resource cannot be maintained. Thus, it gives a great influence to the availability of high quality wood that is reported being decreasing from years to years. Since the market demands is still present, so a better solution need to be find out to fulfill the demands. Many underutilized tropical species such as Sesenduk (*Endospermum diadenum),* Kembang Semangkuk (*Scapium spp.*), Nyatoh (*Sapotaceae spp*.), Sepetir (*Sindora spp*.) and many more has been discovered to have a high potential as a new resources. However, these species has a low density and inherent several poor properties such as low dimensional properties, low in strength and highly risk to be attacked by deterioration agents.

Thus, the improvement of these low qualities of timber is needed in order to produce high quality of timber. Numerous of study have attempted at University Putra Malaysia in order to enhance the properties of low density tropical hardwood by bulking treatment with polymer and also impregnation of polymer followed by curing under heat. Besides that, Hill (2006) also reported that the quality of low density of timber can be enhanced through several chemical treatments. These series of treatment has been proven enhancing the mechanical strength, dimensional stability and durability of this timber against termite and fungi (Izreen *et al.,* 2011, Ang *et al.,* 2014).

However, the demands of environmental timber product increased and give an urged to the timber industry to supply markets with durable timber without addition of chemical. Therefore, thermal modification techniques offer a completely different approach compared with the previous series methods. Recently, researchers at University Putra Malaysia has develop a new thermal modification technique with direct contact of heat treatment using a low density species such as Sesenduk (*endorspemum diadenum*).Trials on using a modification heat treatment technique to improve the quality of timber have been done and the results show good improvements. As a new technique, some parameters are still need to be optimized and the properties of the product need to be identified.

1.3 Objectives

General objective**:** To improve the quality of low – density timber with modified heat treatment method.

Specific objectives:

i. To improve the quality of Sesenduk using Direct Contact Method.
ii. To identify effects of temperature of treatment to physico-mechanical and colour change of Sesenduk.
iii. To determine effects of time of treatment to physico-mechanical and colour change of Sesenduk.
iv. To study effects of thickness of wood samples to physico-mechanical and colour change of Sesenduk.

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