UNIVERSITI PUTRA MALAYSIA

EVALUATION OF THE PROPERTIES OF 4-YEAR OLD RUBBERWOOD CLONES RRIM 2000 SERIES FOR PARTICLEBOARD MANUFACTURE

SYEED SAIFULAZRY OSMAN AL-EDRUS

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

September 2007

Special dedications belong to my beloved family and most of all to my supervisor Assoc. Prof. Dr Paridah Md Tahir

Without them I really cann't go through this. May Allah S.W.T bless all my efforts and works and hopefully this thesis will be useful and helps for those who need it.
Insyaallah…….Amin.

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

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Chairman : Associate Professor Paridah Md Tahir, PhD

Institute : Institute of Tropical Forestry and Forest Products

With drastic depleting rubberwood supply, the Lembaga Getah Malaysia (LGM) has identified new clones of rubber trees that are expected to produce not solely latex but also timber. Among these clones, several clones from RRIM 2000 series were found to be fast growing with high yield of latex, high growth vigor, good growth form and are very suitable for timber production, particularly for the biocomposite industries. In this study, particleboards were manufactured from rubber tree clones of RRIM 2002, RRIM 2020 and RRIM 2025 which are also categorized as Latex Timber Clone (LTC). The properties of these particleboards were compared with those made from the currently planted tree clone ; PB 260. All clones from RRIM 2000 series were planted at 1000-1100 trees planting density and harvested for this study at 4 year-old. The resin used was E1-grade urea formaldehyde (UF) and the

target density of the particleboard was 700 kgm^{-3}. The basic and adhesion properties of these woods were evaluated and discussed in relation to the board performance i.e. physical and mechanical properties, and dimensional stability. These properties were determined according to Japanese Industrial Standard for Particleboard (JIS A 5908-2003). Among the clones studied, RRIM 2002 showed the best overall wood basic properties and board performance, which are comparable to or better than those of matured clone PB 260. The 25-year old PB 260 gives the highest specific gravity (0.601), lowest moisture content (70%), longer fibre length (1.3 mm) and thickest fibre wall thickness (6.2 µm). Clone RRIM 2002 gives comparable wood basic properties except for specific gravity (0.570), higher wood moisture content (94%) relatively longer fibre length (1.4 mm) and thicker fibre wall (5.5 µm). Except for specific gravity, the other two clones give poorer overall wood properties particularly the RRIM 2025. Both clones, however, produced relatively high specific gravity, 0.589 and 0.582 for RRIM 2020 and RRIM 2025. The adhesion properties of all 4-year old clones show almost similar properties. For the particle analysis, PB 260 gives the highest acceptable particle distribution (63.5%), whilst RRIM 2002, RRIM 2020 and RRIM 2025 had respectively, 56.8%, 57.9%, 58.3%. The particleboards of PB 260, RRIM 2002, RRIM 2020 recorded similar modulus of elasticity (MOE) of 2156 Nmm^{-2}, 2145 Nmm^{-2}, and 2122 Nmm^{-2}, respectively, which were significantly higher ($p< 0.05$) than that of RRIM 2025 board (1931 Nmm^{-2}). The board's

strength (MOR) of clones RRIM 2002, RRIM 2020, RRIM 2025 and PB 260 were 20.4 Nmm^{-2}, 19.9 Nmm^{-2}, 18.0 Nmm^{-2} and 21.0 Nmm^{-2}, respectively. The internal bond (IB) of all of the boards ranged from 1.24 Nmm^{-2} to 1.49 Nmm^{-2}, and were not significantly different. Among the four rubber tree clones, PB 260 board was the most stable as indicated by the low values in thickness swelling (RRIM 2002, 22.4 %; RRIM 2020, 21.2 %; RRIM 2025, 19.7 % and PB260, 18.1 %). No significant difference in water absorption of particleboard was found for all clones studied. The overall results indicate that 4-year old rubberwood clones can be used as raw material for particleboard manufacture where clone RRIM 2002 as the most suitable clone as it produced comparable particleboard properties with matured clone particleboard.

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

EVALUASI SIFAT KAYU POKOK GETAH BERUSIA 4 TAHUN DARIPADA KLON SIRI RRIM 2000 BAGI PEMBUATAN PAPAN SERPAI

Oleh

SYEED SAIFULAZRY OSMAN AL-EDRUS

September 2007

Pengerusi : Profesor Madya Paridah Md Tahir, PhD

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Bekalan kayu getah telah berkurangan dengan drastik, justeru itu Lembaga Getah Malaysia (LGM) telah mengenalpasti beberapa klon baru pokok getah yang mana dijangka menghasilkan bukan sahaja untuk susu getah malah untuk kayu. Di antara klon ini, beberapa klon dari siri RRIM 2000 yang didapati membesar dengan cepat, menghasilkan susu getah yang banyak, mempunyai kesuburan tinggi dan bentuk tumbesaran yang baik ini amatlah sesuai untuk penghasilan kayu terutamanya bagi industri biokomposit. Dalam kajian ini, papan serpai dihasilkan daripada klon RRIM 2002, RRIM 2020 dan RRIM 2025 yang mana tergolong dalam Klon Latex dan Kayu (LTC) dan sifat papan serpai ini di bandingkan dengan klon yang telah ditanam secara meluas ; PB 260. Kesemua klon daripada siri RRIM 2000 ditanam pada ketumpatan tanaman 1000-1100 pokok dan ianya ditebang

pada usia 4 tahun bagi menjalan kajian ini. Resin yang di gunakan ialah urea formaldehid (UF) gred-E1). Ketumpatan papan serpai adalah dianggarkan 700 kgm^{-3}. Bagi sifat asas dan perekatan kayu ianya di evaluasi dan di bincangkan dengan menghubung kaitkannya dengan sifat fizikal dan mekanikal papan serta kestabilan dimensinya. Sifat ini ditentukan berdasarkan Standard Industri Jepun bagi Papan Serpai (JIS A 5908-2003). Di antara klon muda yang dikaji, RRIM 2002 menunjukan sifat kayu dan papan serpai yang baik secara keseluruhannya dan setanding atau lebih baik daripada klon matang PB 260. Klon PB 260 memberikan spesifik graviti kayu tertinggi (0.601), paling rendah kandungan kelembapan dalam kayu (70%), gentian yang panjang (1.3 mm) dinding gentian yang paling tebal (6.2 µm). Walau bagaimanapun, klon RRIM 2002 memberikan sifat asas kayu yang setanding kecuali spesifik graviti kayu ; (0.570) dengan kandungan kelembapan yang tinggi (94%), gentian yang terpanjang (1.4 mm), dinding gentian yang lebih tebal (5.5 µm). Klon 4 tahun yang lain terutamanya RRIM 2025, memberikan sifat kayu yang rendah kecuali bagi sifat spesik graviti. Walau bagaimanapun kedua-dua klon ini menghasilkan spesifik graviti kayu yang tinggi; 0.589 dan 0.582 bagi RRIM 2020 dan RRIM 2025. Sifat rekatan bagi kesemua kayu muda menunjukan persamaan. Bagi analisis serpai, PB 260 memberikan hasil serpai bolehguna yang tertinggi (63.5%), manakala RRIM 2002, RRIM 2020 dan RRIM 2025 masing-masing 56.8%, 57.9%, 58.3%. Papan serpai PB 260, RRIM 2002, RRIM 2020

dilaporkan mempunyai persamaan dari segi modulus elastiknya (MOE) dengan masing-masing 2156 Nmm^{-2}, 2145 Nmm^{-2}, dan 2122 Nmm^{-2}, yang mana perbezaan yang bererti ($p< 0.05$) daripada papan serpai RRIM 2025 (1931 Nmm^{-2}). Bagi kekuatan papan serpai (MOR), papan serpai yang diperbuat daripada klon RRIM 2002, RRIM 2020, RRIM 2025 dan PB 260 masing-masing memberi nilai 20.4 Nmm^{-2}, 19.9 Nmm^{-2}, 18.0 Nmm^{-2} dan 21.0 Nmm^{-2}. Kekuatan rekatan dalaman (IB) bagi semua papan serpai adalah sekitar lingkungan 1.24 Nmm^{-2} sehingga 1.49 Nmm^{-2}, dan ianya tidak memberi perbezaan yang bererti. Di antara empat klon pokok getah, papan PB 260 adalah yang paling stabil yang ditunjukan dengan nilai pembengkakkan ketebalan (TS) yang rendah (RRIM 2002 ; 22.4 %, RRIM 2020 ; 21.2 %, RRIM 2025 ; 19.7 % dan PB260 ; 18.1 %). Tiada perbezaan yang bererti bagi sifat serapan air untuk semua klon yang di kaji. Secara keseluruhannya, kayu getah berusia empat tahun ini boleh digunakan sebagai bahan untuk pembuatan papan serpai yang mana klon RRIM 2002 didapati memberikan sifat papan serpai yang setanding dengan sifat papan serpai daripada klon matang (PB 260).

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I would like to express my sincere gratitude to my supervisor, Assoc. Prof. Dr. Paridah Md. Tahir of Institute of Tropical Forestry and Forest Products, for her guidance, encouragement and constructive criticisms, which brought to the completion of this thesis. My sincere thanks are also extended to Dr Wong Ee Ding, Assoc. Prof. Dr Jalaluddin Harun, and Assoc. Prof. Dr Zaidon Ashaari for their comments and critics during my study.

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Last but not least, special thanks to all my friends and staffs of Institute of Tropical Forestry and Forest Products and Faculty of Forestry, who had assist me in the completion of this study.

I certify that an Examination Committee has meet on 20 September 2007 to conduct the final examination of Syeed SaifulAzry Osman Al-Edrus of his Master of Science thesis entitled "Evaluation of the properties of 4-year old rubberwood clone RRIM 2000 series for particleboard manufacture" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that candidate be awarded the relevant degree. Members of Examination Committee are as follows:

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for degree of Master of Science. The members of Supervisory Committee were as follows:

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Date: 21 February 2008

DECLARATION

I hereby declare that the thesis is based on my original work also except for quotations and citations which has been duly acknowledged. I declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions,

SYEED SAIFULAZRY OSMAN AL-EDRUS

Date : 20 February 2008

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
DOS	Department of Statistic
EMC	Equilibrium Moisture Content
FAO	Food and Agriculture Organization
FRIM	Forest Research Institute of Malaysia
FRPC	Fibre Reinforced Plastic Composite
GDP	Gross Domestic Products
ha	Hectare
IB	Internal Bond
ITTO	International Timber Trade Organization
JIS	Japanese Industrial Standards
LGM / MRB	Lembaga Getah Malaysia / Malaysian Rubber Board
LSD	Least Significant Difference
MC	Moisture Content
MDF	Medium Density Fiberboard
MOE	Modulus of Elasticity
MOR	Modulus of Rupture
MTC	Malaysia Timber Council
MTIB	Malaysia Timber Industry Board
MUF	Melamine Urea Formaldehyde

PFE	Permanent Forest Estate
RH	Relative Humidity
RISDA	Rubber Industry Smallholder Development Authority
SAS	Statistical Analysis System
SG	Specific Gravity
TAPPI	Technical Association of Pulp and Paper
TS	Thickness Swelling
UF	Urea Formaldehyde
USDA	United States Department of Agriculture
WA	Water Absorption

CHAPTER 1

INTRODUCTION

1.1 General Background

The export of Malaysian wood based products in 2005 was worth 21.5 billion. Six percent of this amount or RM 1.3 billion were contributed by medium density fibreboard (MDF) and particleboard (Anonymous, 2006a). Since mid 1990's Malaysia has over taken Indonesia and Brazil in becoming the leading producer and world largest exporter of composite panels (ITTO, 2004). According to Najib *et al*. (1997), both particleboard and MDF industries in Malaysia rely 70% of its raw material on rubberwood.

Rubberwood (*Hevea brasiliensis*) which is also known as heveawood, parawood or Malaysian Oak, has shown remarkable success as material for composite industries due to it's light-colour and fine texture with indistinct variation between heartwood and sapwood, suitable strength and good machining properties.

The average consumption of rubberwood logs below 7.5 cm diameter by these industries is estimated to be around 2,000,000 m^3 annually and this amount is expected to increase as a result of chipboard plant expansion by

Mieco Chipboard Sdn Bhd in Kuantan, Pahang (ITTO, 2005). The increase in total consumption, coupled with anticipated reduction in the number of rubber trees to be felled due to the increase in latex price, would inevitably create a dire need to seek for new rubberwood material for these industries.

In the current practice, rubberwood is only extracted from plantation after the rubber tree reaches 25-30 years where it is no longer economical to produce latex (Najib *et al.,* 1997). This practice seems no longer suitable since a substantial amount of rubber tree plantation areas have been converted into oil palm planting schemes. Hence, instead of relying on matured tree stands, the new approach would be to utilize rubberwood in their early growing stage and to implement new planting system *i.e.,* high planting density, to meet the demand by the wood-based products sector especial for composite panel.

To address this issue Lembaga Getah Malaysia (LGM), through the systematic breeding program, has identified 27 clones of the RRIM 2000 series to be planted in their experimental plots of which thirteen (13) clones are Latex Timber Clones (LTC). The latter clones are expected to produce not solely latex but also timber due to the generation of large tree diameter hence increased wood volume per hectare. All rubber tree clones have been categorized by LGM into two groups (Group I & Group II). Each group was then further classified into two subgroups, which are Latex Timber Clones