FIBER MORPHOLOGICAL CHARACTERISTICS OF KENAF CORE AS AFFECTED BY REFINING PARAMETERS

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BY

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A project report in partial fulfilment of the requirements for the degree of Bachelor Science in Wood and Technology in the Faculty of Forestry University Putra Malaysia

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DEDICATION

From the bottom of my heart I dedicate this thesis to my late father that I love so much.

ABSTRACT

The main objective of this study was to determine the effect of refining time on the morphology of refined kenaf and rubberwood fibres at different kenaf-rubberwood ratio. Five kenaf-rubberwood ratios (100K, 100R, 20K: 80R, 30K: 70R, and 50K: 50R) and two refining time (10 and 15 minutes) were used in the refiner at 6 bar pressure. After refined, the fiber obtained were sampled out to evaluate the yield, fibre distribution and fiber morphology. For fibre distribution study, four screening size were used; 0.125, 0.2, 1.0, 2.0, <0.125, and 0.4 mm. In this study, the characteristics observed and measured were length, width, cell wall, and the width of the lumen of kenaf core fiber and rubberwood. Findings shows that 30K: 70R at 10 minutes has the highest yield at 63.33%. All ratio generated fibres with similar distribution as commercial fibre. Furthermore, rubberwood and kenaf core disingly different fibre morphology. The fibre length of rubberwood is 834μm and kenaf core is 689μm based on 0.4mm and <0.125mm screening size.

ABSTRAK

Objektif utama kajian ini adalah untuk menentukan kesan masa penapisan pada morfologi kenaf dan kayu getah gentian halus pada nisbah kenaf-kayu getah yang berbeza. Lima nisbah kenaf-kayu getah (100K, 100R, 20K: 80R, 30K: 70r dan 50K: 50R) dan dua masa penapisan (10 dan 15 minit) telah digunakan dalam penapis pada 6 tekanan bar. Selepas ditapis, serat yang diperolehi telah disampelkan untuk menilai hasil, agihan gentian dan serat morfologi. Untuk kajian agihan gentian, empat saiz saringan telah digunakan; 0.125, 0.2, 1.0, 2.0, <0.125, dan 0.4 mm. Dalam kajian ini, ciri-ciri yang diperhatikan dan diukur adalah panjang, lebar, dinding sel, dan lebar lumen gentian teras kenaf dan kayu getah. Hasil menunjukkan bahawa 30K: 70R pada 10 minit mempunyai hasil tertinggi iaitu 63.33%. Semua nisbah dihasilkan gentian dengan pengagihan yang sama seperti serat komersial. Tambahan pula, getah dan kenaf teras gentian disingly berbeza morfologi. Panjang gentian kayu getah adalah 834μm dan teras kenaf adalah 689μm berdasarkan 0.4mm dan <saiz pemeriksaan 0.125mm.

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APPROVAL SHEET

I certify that this research project report entitled "**Fiber Morphological Characteristics of Kenaf Core As Affected by Refining Parameters**" has been examined and approved as a partial fulfillment of the requirements for the degree of Bachelor Science in Wood and Technology at Faculty of Forestry, Universiti Putra Malaysia.

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CHAPTER 1

INTRODUCTION

1.1 Background of study

Nowadays, the wood based industries are well developed in the global sector. In year 2014, global production of wood-based panels are 388 million m^3 (FAO, 2016). However, the decreasing of natural resources affects the demand of this raw material as a continuing resource for wood industries. There are numerous advantages of using non-wood lignocellulosic for composite manufacture that include of ease to process into composite, which requires relatively low energy input and there are many studies investigated on the potential of non-woody resources to be used in wood based industries by Ndazi et al. (2006).

Most of non-wood fibres are derived mostly from fast growing plants. For the past few decades, non-wood plant fibres have received much attention, especially for composite material applications. In recent study done by Paridah et al. (2015), they have classified the non-wood plants into two main groups namely conventional plant fibres (cotton, kapok, flax, jute, hemp, ramie, kenaf, sisal, abaca, henequen, coir, and bamboo) and non-conventional plant fibres or agro-based fibre residues (corn stalk, wheat straw, rice straw, rice husks, sugarcane/bagasse, pineapple leaf, banana pseudostem, coconut stem, oil palm fibres). Among this non-woody materials, kenaf is one of the promising crops that has been studied in composite manufacture to sustain the timber product industry.

Kenaf (*Hibiscus cannabinus L.)* from Malvaceae family is one of non-woody lignocellulosic biomass. Kenaf is one of the fast growing plants with 5 to 6 m height and can be matured at 4-5 months, closely related to cotton, okra and the hollyhocks (Dempsey, 1975). Kenaf has two different parts in the kenaf plant it is the core as woody part and the bark as a fibrous part from the whole stem. The core of kenaf plant comprised about 60-75% and the bast is about 25-40% from the total weight of the stem (Aisyah et al. 2013). Basically, the bast as commonly used because the most fibrous part from the kenaf stem is comes from bast. Furthermore, Aisyah et al. (2013) stated that the core with bulk density about 0.10 g/cm^3 contain of higher holocellulose is about 31-33% and lignin is 23-27%.

Kenaf (*Hibiscus cannabinus L.)* are being used as raw material in wood based industry especially for particleboard and medium density fibreboard manufacture. Previously, there are several studies reported on the properties of MDF made from kenaf (Nayeri et al, 2014 ; Aisyah et al, 2013). In their study, fibers obtained from kenaf core had a significantly higher flexibility ratio by resulting the tendency of fibers to conform into the surfaces of adjacent fibers (Nayeri et al 2013).

One of the economical ways to use kenaf core as a raw material in MDF manufacture is to combine it with rubberwood. During the refining process using Thermo-Mechanical Pulping (TMP) machine, there are a number of factors that have to be considered since there are differences between kenaf core and rubberwood. The fibre morphology characteristics is differing by refining time. That has parameters being included in refining process likes pressure, temperature, time and raw materials.

1.2 Problem statement and justification

Generally, in the Medium-Density Fibreboard (MDF) manufacturing the common species used comes from wood materials it is rubberwood. However, the refining condition for rubberwood may not be suitable for kenaf. Rubberwood has density of 0.43 to 0.65g/cm^3 and the commercial MDF typically has a density of 0.60 to 0.80 g/cm$^{3.}$ Other than that, kenaf core has low density (0.10–0.20 g/cm3) thus may be good in giving better compaction for MDF. In addition, the fibre will fill up the gap between the rubberwood fibres. Study on refining parameters for admixtured wood raw material has not been reported for kenaf core and rubberwood. Therefore, study on refining parameters suitable for kenaf core and rubberwood fibres are necessary to obtain the optimum refining conditions.

Kenaf is abundant species that can be harvested around 4 times a year. However, kenaf are not commonly used in Malaysia, but the usage of kenaf in commercial production in other countries is well recognized (Anon, 2005). The conditions of the core is light and porous compared to the bast. The fibre length of core is shorter. This situation make the core are not commonly used compared to the bast that contant of much fibrous part. As reported by Nayeri et al. (2013), fibre obtained from kenaf core had significantly higher flexibility ratio, resulting in a tendency of fibres to conform the surfaces of adjacent fibres. For this reason, kenaf core are easy to collapse and therefore has better integrate into panels and MDF-matrix. Therefore, in this study, fibre morphology characteristics of kenaf core as affected by refining time were carried out. The anatomical structures of fibre were included fibre length, fibre diameter, lumen diameter, and cell wall thickness.

1.3 Objectives

1. To determine the effect of refining process of mixture kenaf core: rubberwood on the fibre size distribution.

2. To examine the fibre morphology of refined fibre kenaf core: rubberwood.

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