Physical Properties of Kelempayan *(Neomalarckia cadamba sp.)* wood

Nur Sakinah Mohamed Tamat, Nurfaizah Abd Latib, Siti Nadzirah Misfar & Jamaludin Kasim
Department of Wood Industries, Faculty of Applied Sciences, UiTM Pahang, Jengka, Pahang Darul Makmur, MALAYSIA

Abstract

The physical properties are important factors that influence the workability of a material. The main objective of the study is to determine the physical properties (moisture content and density) of Kelempayan with the diameter of breast height ranging between 35cm to 41cm. Kelempayan was harvested from three trees. The trees were cut into three height levels (bottom, middle and top). Samples were taken from each height level and along the radial direction of the stem (near pith, middle and near bark). The highest density of Kelempayan according to the height level was found at the top portion, followed by middle and bottom portion. Along the radial direction, it was showed that the density was highest at near bark followed by middle and near pith. Percentages of moisture content decreased insignificantly from bottom to top portion.

Keywords: Kelempayan, *Neomalarckia cadamba*, physical properties, moisture content, density.

INTRODUCTION

Neomalarckia cadamba is locally known as Kelempayan comes under the family of Rubiaceae. It is a fast-growing tree species with a tall and straight bole. The timber is soft and light with creamy yellow colour of wood. It is classified under Light Hardwood in Malaysia. This type of wood is regarded as non-durable and also susceptible to wood rotting to fungi and blue stain. The tree has a potential to be utilized for sawn timber, veneer, chips, pulp and composites (Ismail et. al., 1995). As it is a fast-growing species, it could become as an alternative raw material to support wood industries. The water has influence on the properties of wood especially affecting its strength, shrinkage, density and the ability to fungi and insect attacked. Basically, strength properties of timber depend very much on the amount of moisture. The objectives of this study are to determine the physical properties of Kelempayan wood according to tree height (bottom, middle and top) and along the radial direction of the tree (near pith, middle and near bark) and to study the correlation of tree height and distance along the radial direction to its physical properties.

MATERIALS AND METHODS

Three Kelempayan trees with a diameter at breast height (DBH) ranging between 35cm to 41cm were harvested from the UiTM Pahang forest reserve and divided into three equal portions namely bottom, middle and top. Two pieces of disc were taken from each portion of fresh Kelempayan. Then, each of the discs will be marked and cut into small sample according to the distance across the disc which is near pith (NP), middle (M) and near bark (NB).

Moisture content

The method used for the determination of moisture content was based on BS 373:1957 Testing Small Clear Specimen of Timber.The same wood samples from the determination of basic density were used. The samples were oven-dried at the temperature of 103±2 °C for about 24 hours until constant weight. The samples were cooled for about half an hour in a dessicator and weighed. The moisture content was calculated as follow:

$$MC = \frac{W_g - W_o}{W_o} \times 100\%$$

Basic density

Basic density was determined based on water displacement method. The testing was carried out according to the BS 373:1957 Testing Small Clear Specimen of Timber. The basic density of the wood samples was calculated as below:

$$\text{Basic density } (g/cm^3) = \frac{\text{oven-dried weight (g)}}{\text{Volume of water displaced } (cm^3)}$$

Let: W_g = weight of green sample in grams

W_o = weight of oven-dried sample in grams

RESULTS AND DISCUSSIONS

Table 1 gives the average values of oven-dry density and moisture content according to portion and distance. Oven-dried density was observed to show an increasing trend from bottom to top portion and from near pith to near bark. In contrast, moisture content is decreasing from top to bottom and from near pith to near bark. The result of the DMRT and correlation analysis was shown as in Table 2 and Table 3.

The analysis of variance (ANOVA) on physical properties of Kelempayan wood is summarized in the Table 2. It shows that both moisture content and density value of Kelempayan wood according to portion was not significantly different. However the radial position gives significant effect on moisture content but not for the density value. As for the interaction Portion x Distance, it showed no significant difference.

Table 1: Average value for moisture content and density of Kelempayan *(Neomalarckia cadamba)* wood according to its portion and distance on the tree.

Portion	Distance	Moisture content (%)	Density (g/cm3)
Bottom	NP	134.71	0.35
	M	107.05	0.36
	NB	94.75	0.40
Middle	NP	116.73	0.36
	M	104.04	0.36
	NB	95.67	0.38
Top	NP	115.78	0.38
	M	98.60	0.39
	NB	93.31	0.41

Table 2: Summary of ANOVA on the moisture content and density of Kelempayan *(Neomalarckia cadamba)* wood influenced by portion and distance of the tree.

Source of Variation	Moisture content (%)	Density (g/cm^3)
Portion	2.179^{ns}	0.805^{ns}
Distance	18.223^{*}	1.459^{ns}
Portion x Distance	0.909^{ns}	0.096^{ns}

Note: * shows F value significance at P value < 0.05, ns shows F value not significance at P value < 0.05

From Table 3, it was found the density of Kelempayan increased with height. The increase of density from bottom to top could be due to the juvenile wood properties. Gorišek et. al (Google, 2004) stated that juvenile wood has anatomical characteristic and physical properties which are different as those in mature wood. Kelempayan is a fast-growing tree. Fast-grown plantation resources will tend to be harvested in a short age rotations. This makes the timber to have higher proportions of juvenile wood in comparison to traditional harvesting (Gorišek et. al, Google, 2004). Panshin & Zeeuw (1970) stated that faster growth rates tree could reverse the pattern of specific gravity increasing with height as a resultant of a number of inherent factors modified by growth conditions. However, it is only partly understood. Even though the density on the top was higher than the bottom, however, the difference was not statistically significant. Therefore, the strength properties of Kelempayan along the stem height were not greatly affected. Along the distance of the stem, moisture content decreases from near pith to near bark. As a result, the density increases towards the outer portion of the trunk. The same pattern was found by Zziwa et. al (2006) in four less utilized tropical timber species in Uganda. The increasing pattern

of density from near pith to near bark is associated with the transition of juvenile wood into mature wood.

Table 3: Moisture content and density of Kelempayan *(Neomalarckia cadamba)* wood influenced by portion and distance of the tree

Source of Variation	Moisture content (%)	Density (g/cm3)
Portion	2.179^{ns}	0.805^{ns}
Distance	18.223^{*}	1.459^{ns}
Portion x Distance	0.909^{ns}	0.096^{ns}

Note: Values with the same alphabetical superscript in each column indicates groups that are not statically different according to Duncan's multiple range tests at $P < 0.05$

Table 4 gives the correlation analysis of moisture content and density of Kelempayan with portion and distance. In the correlation analysis, the moisture content was observed to decrease from near pith to near bark ($r = -0.624$). The decreasing of moisture content from near pith to near bark is associated by the transition of juvenile wood at near pith to mature wood at near bark. The wood at the outermost portion of the tree have thicker cell wall and small lumen as compared to the wood at the innermost portion which has thinner cell wall and large lumen (Josue, 2004). This may resulting in low storage of water in the wood region near the bark, thus lowered the moisture content of the wood.

Table 4: Correlation coefficients of moisture content and density with portion and distance.

	Portion	Distance
Moisture content	-0.219	-0.624^{**}
Density	0.133	0.235

Note: * shows value significance at $P < 0.05$

CONCLUSIONS

The density of *Neolamarckia cadamba* increased from bottom to the top portion within the radial direction, the density was highest at near bark followed by middle and near pith. Kelampayan portion and radial direction, however, showed no significant effect on the properties studied. Percentages of moisture content also decreased insignificantly from bottom to the top portion.

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