Resistance of Particleboard Made from Fast Growing Species to Subterranean Termite Attack

by

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Abstract

Particleboards were made from jabon (*Anthocephalus cadamba*), sungkai (*Peronema canescens*), mangium (*Acacia mangium*), and equal mixed of these species. Density targets of the board were 0.60 g/cm^3 and 0.80 g/cm^3 using urea formaldehyde with resin content 12% and 2% paraffin was added. The mats were hot-pressed at 130^{o}C and 25 kg/cm^2 pressure for 10 minutes. The boards were tested to subterranean termite (*Coptotermes curvignathus* Holmgren) in laboratory regarding to Indonesian standard SNI 01.7207–2006 during four weeks. The results showed that higher wood density had higher resistant to termite attack which was indicated by lower mass loss and feeding rate. Furthermore particleboard composed from higher density wood had higher resistant to subterranean termite attack, and the most resistant particleboard was composed from magium (wood density 0.60 g/cm^3) followed by sungkai (wood density 0.46 g/cm^3), mixed species, and jabon (wood density 0.41 g/cm^3).

Key words: particleboard, fast growing species, subterranean termite, weight loss, feeding rate, Indonesian standard test for subterranean termite.

Introduction

Since year 2000 Indonesian forestry has been supplying logs about 60% from plantation forest, it was a great changed because prior to the year logs was supplied 90% from natural forest (calculated data from Ministry of Forestry, 2009). About four million hectares of fast growing species has been developed with cutting cycle of 10-15 years, e.g. mangium (*Acacia mangium*), teak (*Tectona grandis*), mahogany (*Swietenia macrophylla*), pine (*Pinus merkusii)*, sengon (*Paraserianthes falcataria),* sonokeling (*Dalbergia latifolia*) and sungkai (*Peronema canescens*) (Rohadi, 2010). Recently jabon (*Anthocephalus cadamba*) becomes populer because of fast growth, cylindric stem, few knots, light color and density about 0.43 (Anonymous, 2010).

Wood from plantation forest generally has a lot of juvenile wood and the wood is inferior in physical-mechanical properties and durability comparing to mature wood. However, houses in Indonesia which are mostly built using mature wood are not spared from termite attacks. In 1995 the economic loss of various buildings due to termite attack was about USD 200 mil (Rakhmawati 1995) and in 2000 it was USD 200–300 mil (Yoshimura and Tsunoda 2005). Thus, in future, when wood from plantation forest replaces natural wood, it is assumed that the loss will increase if the juvenile wood is not preserved prior to use for building materials.

On the other hand, Massijaya *et al*. (2010) mentioned that small diameter logs from fast growing species is prospectable for bio-composite products, such as plywood, particleboard,

fiberboard, cementboard, glulam, laminated veneer lumber and other products, and these products could fulfill standard for physical and mechanical properties, but it was not mentioned for durability characteristics. It can be suggested that the durability of bio-composite products is similar to its solid wood, for this reason the resistance of bio-composite product especially particleboard made from fast growing species to subterranean termite should be recognized.

The purpose of this work is to determine resistance of particleboard made from fast growing species especially jabon, sungkai, mangium, and mixed of these species to subterranean termite attack in laboratory test.

Materials and methods

Materials

Three small diameter logs were used for manufacturing of particleboards, i.e. jabon (*Anthocephalus cadamba*), sungkai (*Peronema canescens*), mangium (*Acacia mangium*), and equal mixed of the three species was also used. Density targets of the boards were 0.60 g/cm^3 and 0.80 g/cm^3 using urea formaldehyde as a binder with resin content 12%, and 2% paraffin was added to improved the water resistant. The hand formed particle mats were hot-pressed at 130^{o}C temperature, 25 kg/cm^2 pressure for 10 minutes, and the board size was 30 cm x 30 cm x 1 cm in length, width and thicknes respectively.

Subterranean termite test

Wood sample was put in and touched to a jam pot containing 200 g of sand (7% moisture content under water holding capacity) and 200 healthy and active worker of subterranean termites (*Coptotermes curvignathus* Holmgren). The jam pots were put in the dark room for four weeks, and each week the bottles were weight and if moisture content of the sand reduced 2% or more, water was added to reach moisture content standard. At the end of the test, particleboard weight loss was determined regarding to SNI 01.7207–2006 (Indonesian National Standard, 2006), and feeding rate was also calculated.

Data Analysis

Factorial 2 by 4 in completely randomized design was used to analyze the data, the first factor was board density namely medium density particleboard (0.60 g/cm^3) and high density particleboard (0.80 g/cm^3), and the second factor was wood species namely jabon, sungkai, mangium, and equal mixed of the three species.

Results and discussion

Weight Loss

Weight loss percentage for each wood species and particleboard density is shown in Table 1, analysis of variance is shown in Table 2. From Table 1 it was seen that higher wood density had lower wood mass loss percentage, and could be interpretated that higher wood density had higher resistant to *Coptotermes curvignathus* termite attack, and this result was similar to Arango *et al*. (2006) who mentioned based on the six hardwood species indicate a significant inverse association between percentage mass loss and specific gravity or with other term higher specific gravity wood has more resistant to *Reticulitermes flavipes* termite. Furthermore it can be seen that particleboard resistant to termite attack was aligned to its composed wood or in other term more resistant wood

producing more resistant particleboard to termite attack.

Tabel 1. Weight loss (%) for each wood species and particleboard density

Particleboard	Jabon	Sungkai	Mangium	Mixed
Medium Density	6.9	4.5	4.1	6.2
High Density	5.1	4.3	3.6	5.4
Solid Wood	8.4	3.5	2.3	-
Wood Density	0.41	0.46	0.60	

Tabel 2. Analysis of variance for weight loss and feeding rate

Factor	Weight Loss		Feeding Rate	
	F value	Sign level	F value	Sign level
Board density	3.50	0.08	1.57	0.23
Wood species	5.62	0.01	3.41	0.04
Interaction	0.65	0.59	0.02	0.99

According to analysis of variance at Table 2, particleboard density and interaction of both factors did not affect particleboard mass loss, but wood species did at 1% significant level. Board composed from higher density wood had lower mass loss, in this research the most resistant board was composed from magium (wood density 0.60 g/cm^3) followed by sungkai (wood density 0.46 g/cm^3), mixed species, and jabon (wood density 0.41 g/cm^3).

Feeding Rate

Feeding rate (µg/termite/day) for each wood species and density of particleboard is shown in Table 3, analysis of variance is shown in Table 2. From Table 3 it was seen that higher wood density had lower termite feeding rate, this fact was aligned with board mass loss, and it could be interpretated that higher wood density had higher resistant to subterranean termite attack.

Tabel 3. Feeding rate (µg/termite/day) for each wood species and particleboard density

Particleboard	Jabon	Sungkai	Mangium	Mixed
Medium Density	83.8	60.6	53.5	90.2
High Density	92.3	73.6	67.0	100.7
Solid Wood	89.5	34.5	29.3	-

According to analysis of variance at Table 2, particleboard density and interaction of both factors did not affect termite feeding rate, but wood species did at 4% significant level. Board composed from higher density wood had termite feeding rate, in this research the lowest feeding rate was composed from magium followed by sungkai, jabon, and mixed species.

Conclusions

From discussion above, it could be concluded that:

1. Higher wood density had higher resistant to termite attack.
2. Particleboard resistant to termite attack was aligned to its composed wood or in other term more resistant wood species producing more resistant particleboard to termite attack.
3. Wood species affected board mass loss and termite feeding rate, board composed from higher density wood had lower mass loss and termite feeding rate as well, or in other term board composed from higher density wood had higher resistant to subterranean termite attack.
4. Board density and interaction of board density and wood species did not affect board mass loss and termite feeding rate.

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