

## Subterranean Termite Resistance of Polystyrene Wood from Three Tropical Wood Species

by

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### Abstract

Timber from a plantation forest has inferior resistant to subterranean termite attack compared to timber from a natural forest, because stands are cut at a young age and the timber consist of a lot of sapwood and juvenile wood in the heartwood. Polystyrene impregnation is a way to increase resistance to termite attack of the wood. Sengon (*Falcataria moluccana*), mangium (*Acacia mangium*), and pine (*Pinus merkusii*) were impregnated with polystyrene at polymer loadings of 26.0%, 8.6%, and 7.7%, respectively. The wood specimens were tested in the ground for three months. The weight loss of untreated sengon, mangium, and pine were 50.3%, 23.3%, and 66.4% %, respectively, and polystyrene wood 7.6%, 14.4%, and 5.1%, respectively. The polystyrene wood was more resistant than untreated wood to subterranean termite attack in the field test.

**Key words:** subterranean termite, polystyrene wood, weight loss, resistance class.

### Introduction

Indonesian log production in 2013 reached 23.23 million m<sup>3</sup>, and 84% was from plantation forest that included wood such as sengon (*Falcataria moluccana*), mangium (*Acacia mangium*), pine (*Pinus merkusii*), and gmelina (*Gmelina arborea*) (Ministry of Forestry, 2014). The logs were cut from young stands, 5 to 10 years old, resulting the timber had a lot of sapwood and juvenile wood in the heartwood (Fajriani, 2013).

Indonesia as a tropical country has a good environment for termites especially subterranean termites that could attack wooden building. Nandika (2015) mentioned that all parts of the country have been attacked by subterranean termites, including all districts in Jakarta. Furthermore, it has been mentioned that the economic loss was about US\$ 1 million in 2015.

Juvenile wood has inferior characteristics in terms of physical-mechanical properties and therefore resistance to termite attack. Hadi et al. (2013; 2015a) mentioned that jabon wood (*Anthocephalus cadamba*) impregnated with methyl methacrylate had better physical-mechanical properties and resistance against subterranean termite (*Coptotermes curvignathus*) attack in laboratory tests according to the Indonesian standard. Furthermore Hadi et al. (2015b) treated mindi wood (*Melia azedarach*) from Indonesia with a density of 0.43 g/cm<sup>3</sup> and sugi wood (*Cryptomeria japonica*) from Japan with a density of 0.34 g/cm<sup>3</sup> of polystyrene resulting in those woods being more resistant against subterranean and drywood termites (*Cryptotermes cynocephalus*) in laboratory test according to the Indonesian standard.

The purpose of this study was to determine the resistance of polystyrene impregnated wood from three fast-growing tree species against subterranean termite attack.

### Materials and Methods

#### Wood specimen preparation

The wood species sengon, mangium, and pine from Bogor, West Java, Indonesia, were used to determine resistance to subterranean termite attack. Test specimen size was 1 cm by 2 cm in cross section, and 20 cm in longitudinal direction according to Hadi et al. (2005). Impregnation of polystyrene was conducted to air-dried wood samples placed under vacuum at 600 mm Hg for 30 min, followed by immersion in monomer styrene at 10 g/cm<sup>2</sup> for 30 min. The wood samples were

then wrapped in aluminum foil and placed in an oven at 100 °C for 24 h. The aluminum foil was removed and samples weighed for polymer loading calculation.

### In-Ground Test

The test specimens were placed vertically in the ground with half the length in the ground at the arboretum of Bogor Agricultural University Campus for three months. At the end of the test, each specimen was measured for weight loss according to the equation:

$$WL = (W1 - W2) / W1 \times 100\%$$

where W1 = weight of oven-dried wood prior to the test (g); and W2 = weight of oven-dried wood after the test (g).

## Results and Discussion

The mean value and standard deviation of wood density, polymer loading, resistance class and percent wood weight loss to subterranean termite attack of untreated and polystyrened wood is shown at Table 1.

Table 1. Wood density, polymer loading, resistance class to subterranean termite attack, and wood weight loss of untreated and polystyrened woods.

Wood Species	Density (g/cm <sup>3</sup> )	Polymer Loading (%)	Resistance Class*	Wood Weight Loss (%)	
				Untreated	Polystyrene
Sengon	0.34 (0.01)	26.0 (5.4)	V	50.3 (36.8)	7.6 (2.5)
Mangium	0.51 (0.01)	8.6 (4.8)	IV	23.3 (8.1)	14.4 (7.0)
Pine	0.69 (0.01)	7.7 (2.3)	V	66.4 (18.6)	5.1 (4.3)

Remarks: Values in the parentheses are standard deviation. \* According to Arinana et al. (2012).

From Table 1 it can be seen that polymer loading of sengon was the highest followed by mangium and pine, and that order related to wood density from lower to higher values. Hadi et al. (2015) mentioned that a lower density wood was more easily penetrated by styrene monomer, borax, and acetic anhydride, because it has more voids compared to higher density wood.

Sengon and pine wood species had very poor resistance (class V) and mangium had poor resistance (class IV) to subterranean termite attack according to the SNI 2006 (Arinana et al. 2012) when test specimens were taken from trees 5 to 10 years old. The wood specimens were mostly sap wood as indicated by the light color of the wood (Fajriani et al. 2012).

Wood specimen weight loss of mangium (class IV) was lower than sengon and pine (both class V).. Even though wood density of mangium 0.51 g/cm<sup>3</sup> was lower than pine with 0.69 g/cm<sup>3</sup> but mangium had better resistant because wood resistance to biodeterioration was not related to wood density but the amount of toxic extractive content.

The average weight loss of untreated wood was 46.7% and polystyrene wood was 9.0%, indicated that polystyrene wood had much better resistant than untreated wood to subterranean termite attack and this result was in-line with Hadi et al. (2015).

## Conclusions

The lower density wood had higher polymer loading of polystyrene compared to higher density wood. Sengon and pine woods had very poor resistance and mangium poor resistance to subterranean termite attack. Polystyrene wood had much better resistance than untreated wood to subterranean termite attack.

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