

## **The Subterranean and Drywood Termite Attack on Used Ironwood (*Eusideroxylon zwageri* T. et B.) Flooring from a House**

by

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### **Abstract**

Ironwood (*Eusideroxylon zwageri* T. et B.) has long been known for having high quality, so it is usually used as the material of house building, among others uses as house flooring. This study aimed to determine the durability of the ironwood used for the floor of the house which has a long life of use (68 years). In this study, we also evaluated ironwood from logs of two diameters; 10- and 25-cm. The three kinds of ironwood were tested for their durability using graveyard test for subterranean termite attack; a laboratory test for subterranean termite attack; and a laboratory test for drywood termite attack. The test was conducted based on the SNI 01-7207-2006 “The resistance test of wood and wood products against wood destroying organisms”. To determine the modulus elasticity of wood, a laboratory test was conducted based on the regulation ASTM D143-09 “Standard Test Methods for Small Clear Specimens of Wood”. The results showed that the average values of percent weight loss of 3 kinds of ironwood tested toward subterranean termites had a value less than 3.52% and drywood termite less than 2% as the regulation stated, were rated as durable class 1; the first assumed that the use of quality materials for building structural was a high quality material, but the stiffness value of the used ironwood house flooring was lower than the two previous values due to the influence of that materials long service life.

**Keywords: durability, termite attack, used ironwood flooring of house, subterranean termite, drywood termite**

### **Introduction**

Ironwood (*Eusideroxylon zwageri* T. et B.) has long been known as having high quality, being resistant to termites and other natural conditions, but the ability of regeneration and growth is slow. Nowadays, the presence of this species is in danger because of increasing human needs.

Government forests and forest plantation companies are already starting to cultivate and promote planting ironwood in order to anticipate the extinction and to keep the availability of ironwood in the market. In the forest ironwood has been cut when trees are at 60-80 cm in diameter trees in the cultivation land it is usually cut at 20-30 cm and even 10 cm. Consequently, it is important to do research to know the durability of ironwood at a young age for logging consideration.

Ironwood is one of Indonesia's tropical plantation trees, known in Indonesia as ulin or belian. Ironwood is dense with an average specific gravity of 1.04 and Class 1 strength and durability (Martawijaya *et al.* 2005), yet it is easily worked. It is used widely for various purposes, such as structural component pilings in wetlands, roof shingles, house frames, floors and doors.

There are few uses of wood in which its serviceability is not some-what dependent upon one or more strength properties. Often strength in combination with other important properties is required. The floor requires not only the capacity to carry loads, but also resist decay. The durability of the floor should be considered, especially floors near the soil surface.

## **Materials and methods**

The wood used in this research was ironwood (*Eusideroxylon zwageri* T. et B.) from a Plantation in South Kalimantan. Three kinds of wood were tested consisting of ironwood used for the floor of a house which had a long service life (68 years) and included ironwood from the plantation cut from logs with a diameters of 10- and 25-cm.

This research was conducted using three types of tests, namely the graveyard test for subterranean termite attack; a laboratory test with the subterranean termite (*Coptotermes curvignathus* Holmgren); and a laboratory test with the drywood termite (*Cryptotermes cynocephalus* Light). The test methodology referred to the Indonesia National Standard SNI 01-7207-2006 "The resistance test of wood and wood products against wood destroying organisms". To determine the modulus elasticity of wood, a laboratory test was conducted based on the regulation ASTM D143-09 "Standard Test Methods for Small Clear Specimens of Wood".

### **Graveyard tests for subterranean termite attack**

Graveyard tests were carried out at the Arboretum Forestry Faculty of Bogor Agricultural University, where a population of Subterranean Termites can be found, for a period of 8 (eight) weeks. The ironwood stake dimensions were 20 x 20 x 200 mm (width, height, and length respectively) were plugged into the ground at a distance of 50 cm from each other. Stakes were oven dried at 103°C before

being installed in the test. The stakes were removed from the Arboretum, washed and then cleared of debris. After that, stakes were conditioned at room temperature then oven at 60<sup>0</sup> C for 48 hours to obtain uniform moisture content. The stakes were than weighed to determine the percentage weight loss.

#### **Laboratory test by subterranean termites attack**

Ironwood was cut into blocks with a length, wide, and thickness of 2.5 cm x 2.5 cm x 0.5 cm respectively. A single ironwood block was inserted into a jam pot, laid by standing on the base of the jam pot and propped such that one of the widest faces of sample wood touched the glass wall. 200 grams of moist sand that had 7% moisture content, below water holding capacity, was added to the jam pot. Furthermore 200 healthy and active subterranean termite (*Coptotermes curvignathus* Holmgren) workers were put into the jam pot and the test unit stored in a dark place for four weeks. The classification of wood resistance against subterranean termites by percent weight loss can be seen in Table 1.

Table 1 Classification of wood resistance against *subterranean* termites by percent weight loss

Class	Resistance	Weight Loss (%)
I	Highly Resistant	< 3.52
II	Resistant	3.52 – 7.50
III	Moderate	7.50 – 10.96
IV	Poor	10.96 – 18.94
V	Very Poor	18.94 – 31.89

#### **Laboratory test by drywood termite attack**

A 1.8 cm diameter and 3 cm height glass tube was used. The ironwood sample was made with a size of 5 cm x 2.5 cm x 2.5 cm. One side (the widest part) of the ironwood sample was placed against the end of the glass tube. Then 50 healthy and active worker termites of *Cryptotermes cynocephalus* Light were put into the glass tube and it was covered with cotton. The glass tube test units were stored in a dark place. The weight loss of the ironwood sample was recorded after 12 (twelve) weeks exposure to the termites. The classification of wood resistance against drywood termite attack using percent weight loss can be seen in Table 2.

Table 2 Classification of wood resistance against dry wood termites by percent weight loss

Class	Resistance	Weight Loss (%)
I	Highly Resistant	< 2.0
II	Resistant	2.0 – 4.4
III	Moderate	4.4 – 8.2
IV	Poor	8.2 – 28.1
V	Very Poor	> 28.1

### The bending test in laboratory

The ironwood beam was placed on top of two placements which were given load in the center of the span and the resulting deflection measured. The equipment used in this bending test was a Universal Testing Machine with loading capacity of 50 KN, and a computer with supporting soft- and hardware. Before the tests were conducted for each beam, measurement of the beam cross section was done, i.e. the beam width and height was measured at two spots, which were to be used in the calculation of modulus of elasticity. Additional load was given with prediction of bending stress within elastic limits. On every additional load, reading of the deflection measurement in the middle of the span was done. The speed of loading was 3 mm/minute. The estimate that the tests were within the elasticity limits, was done by defining the largest loading by calculating the bending stress that might emerge. Based on the data, a correlation curve of force and deflection was illustrated; the slope angle of the curve was used to calculate the wood modulus of elasticity.

### Results and discussion

The used ironwood tested was a component of wood flooring of house built 68 (sixty eight) years ago, so it was built around the year 1945. We cannot know the age of planting the timber or the log diameters used in making this flooring. But generally wood used for building structural components are chosen from good quality wood.

The results from laboratory test showed that the average values of percent weight loss caused by subterranean termites (*Coptotermes curvignathus* Holmgren) for 10- and 25-cm diameter logs of ironwood were 0.40% and 0.33% respectively, and 0.23% for used flooring ironwood, Figure 1. The ironwood sample from smaller diameter logs had a higher average value for percent weight loss than higher diameter logs. The used flooring had a smaller value than both samples from recently cut trees in the laboratory tests.

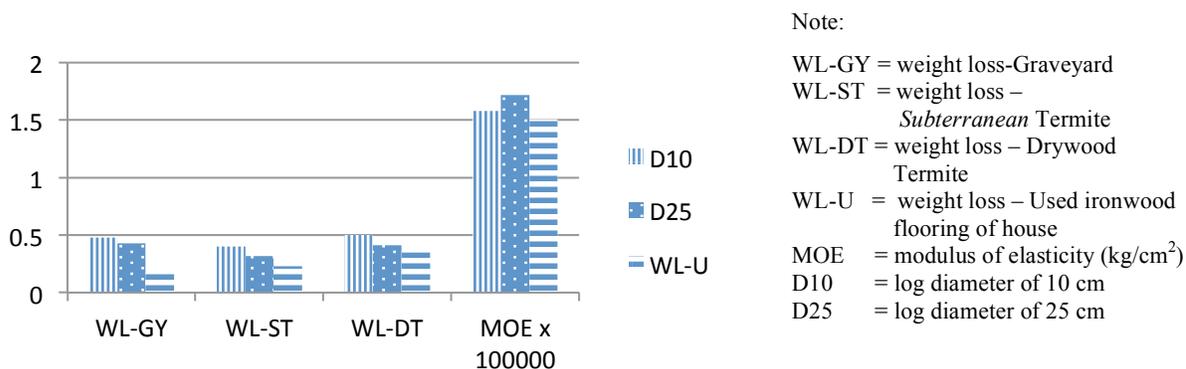


Figure 1 Weight loss and modulus of elasticity of ironwood

Based on this research, the results from the laboratory test showed that the average values of percent weight loss caused by drywood termites (*Cryptotermes cy노cephalus* Light) for 10- and 25-cm diameter ironwood samples were 0.50% and 0.41% respectively, and 0.35% for used flooring ironwood. From these tests it appears that the ironwood sample from the smaller diameter log had higher average values of percent weight loss than the larger diameter logs. The used flooring ironwood had a lower value than both of the logs.

All of the laboratory test results showed that average values of percent weight loss of the 3 kinds of ironwood tested against subterranean termites had values less than 3.52% and dry wood termites less than 2% and according to the regulation, they have a rating of durable class 1.

The results from graveyard test showed that the average values of percent weight loss caused by subterranean termites (*Coptotermes curvignathus* Holmgren) for 10- and 25-cm diameter logs of ironwood were 0.48% and 0.43% respectively, and 0.17% for used flooring. Same as the results of the two laboratory tests above showed the smaller diameter logs had a higher average value for percent weight loss than the larger diameter logs. The used flooring ironwood had a smaller value than both of the diameter test logs.

Ironwood has good performance against subterranean and drywood termite attack and our results are in accordance with research of Wardani and Hadi (2011) which states that the durability of ironwood aged at 70 years (diameter 36 cm) from a natural forest has a durable class I to attack by the subterranean termite (*Coptotermes curvignathus*).

The percent weight loss value of used ironwood flooring was always lower than the other test samples from 10- and 25-cm diameter logs. This happens because the wood has been used to carry the load or the weather changes for quite a long. Due to its hard texture and heaviness, iron wood is difficult

to absorb wood coatings and stains. On top of that, under sunlight, heat or loading, iron wood surfaces will tend to crack. It is possible this cracking decreases the stiffness, strength and the durability. When the area consumed by termite was deeper, it resulted in less stiffness compared to an area consumed by termites that is not as deep but wider (Sulistyawati *et al.*, 2010).

The ironwood tested in the laboratory to evaluate rigidity is shown in Figure 1, it can be seen that the value of stiffness or Modulus of Elasticity (MOE) of the 10- and 25-cm diameter logs ironwood were  $1.58 \times 10^5$  kg/cm<sup>2</sup> and  $1.72 \times 10^5$  kg/cm<sup>2</sup> respectively. Used ironwood flooring had a value of  $1.51 \times 10^5$  kg/cm<sup>2</sup>. The bigger log diameter had the higher rigidity value, or the older age of plantation ironwood had the higher value of rigidity. MOE value or rigidity or stiffness of used ironwood flooring was lower than the other two previous values. We assume the use of quality materials for structural building and this quality influences the material service life.

## Conclusions

From the results of this research, we can conclude that used ironwood flooring had less percent weight loss than ironwood from 10- and 25-cm diameter log caused by subterranean termite (*Coptotermes curvignathus* Holmgren) and drywood termite (*Cryptotermes cynocephalus* Light) attack; the average values of percent weight loss of the 3 kinds of ironwood toward subterranean termites was less than 3.52% and against drywood termite less than 2% making them according to the regulation, durable class 1; we assumed that the use of quality materials for building structures was high, but the stiffness value of used ironwood flooring was lower than the two previous values, this reason was due to the influence of the material service life, especially after 68 years.

## References

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