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Comparison of Accelerated Decay and Graveyard Test on Selected Malaysian Timber Species

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Abstract

The natural durability of timber may be defined as 'inherent resistance of timber to attack by wood deterioration agents such as wood decaying fungi and wood destroying insects'. In Malaysia, natural durability of timber is determined using a 'graveyard' test. The average time taken for this test is more than 10 years. The results of this test method do not provide information on longevity (service life) either out of ground contact, or in other geographical locations. Comparison of natural durability requires the use of standard test method where for example in Europe, the accepted laboratory method is EN 350-1. This paper briefly describes the rating of natural durability based on comparison results of the two test methods stated i.e the exterior graveyard test and the interior laboratory test.

1. Introduction

The natural durability of timber may be defined as 'the inherent resistance of timber to attack by wood destroying organisms such as wood decaying fungi and wood destroying insects' and also the degree of resistance to deterioration by the whole range of biological, chemical, mechanical and physical wood-destroying agents or simply as the number of years the timber can last under a particular service condition, against wood destroying organisms and the elements of the weather (Ani. S., et al, 2005) [1]. Wood is used in a broad range of applications and environmental conditions that can influence the service life of wooden structures. One of the most rigorous applications is when wood is exposed to the outdoor and ground contact because of the favourable conditions for wood-destroying microorganisms.

In Malaysia, natural durability of timber is determined using a 'graveyard' test. In the test, wood stakes 50 mm x 50 mm in section are inserted in the ground so that half of the length of the stake is buried. The average time taken for these stakes to fail is used to assign a natural durability rating. In Malaysia, four natural durability ratings exist (Table 1).

Table 1: Natural durability ratings

Malaysia natural durability rating	Life expectancy
Very durable	More than 10 years
Durable	5 to 10 years
Moderately durable	2 to 5 years
Non-durable	Less than 2 years

Whilst this method compares natural durability of timbers in ground contact in the tropics, these results do not provide information on longevity (service life). The most acceptable scientific study in evaluating the durability of timber is by the Graveyard test, where timbers of standard size are buried in the ground and the length of time taken by these timbers to remain sound is computed as the durability rating of the timbers. While this method gives an excellent "relative" durability of the timbers tested, it does not

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really reflect the actual durability of the timber during service, especially under conditions that are not similar to those employed in the test. To those who are not familiar with durability test of timbers may assume that the published data on the durability of timbers are directly comparable, ignoring the fact that the tests were performed under different environmental conditions. For example, Kapur which is rated as Moderately Durable (2-5 years) when tested under the Malaysian conditions has been found to last for 25 years in the United Kingdom.

Previously, the durability of timbers is usually based on the results of field trials, where assessments are made on the actual performance of each individual species against fungal and termite attacks. Previous report recorded that about 200 timber species from Peninsular Malaysia (Dahlan & Tam, 1985, 1987) [2,3] were grouped into four durability classes ranging from non durable to very durable depending on their years of service life. Comparison of natural durability requires the use of a standard test method. In Europe, the accepted method is EN 350-1. The influence that different environmental conditions have on decay may be overcome through comparing the rate of decay against a standard reference species.

Natural durability of selected Malaysian wood is determined by the European standard BS EN 350-1: (1994) and EN 113 (1997) for basidiomycetes in the laboratory where the main factors such as temperature and humidity are controlled. Both standards provide guidance on requirements for natural durability of wood against wood decaying organisms in different rating classes. The natural durability of the wood species can be determined faster in laboratory test as specified by EN 113. The durability rankings obtained can be directly compared with other species assessed using this standard.

The aims of this research are:

a) To assess performance of naturally durable wood species in aboveground test
b) To assess the effectiveness and natural durability of selected Malaysian wood by laboratory test

2. Materials and Methods

2.1 Graveyard test

The durability of timber specimen was evaluated based on average service life [4] of the test specimen when they were partially buried in outdoor ground contact. The test specimens of the size 600 mm long and50 mm square in cross-section were obtained from logs of botanically identified trees. The specimens were buried up to two third (2/3) of their lengths in the ground and were placed 2 feet apart, with each stake in contact with those on either side. A test stake was considered to have reached the end of its useful service life when 50% of its cross sectional area was destroyed by fungi or termites (Figure 1). The durability classification referred only on the heartwood of timber species as sapwood of almost all timbers is non-durable.

Figure 1: Graveyard test

2.2 Accelerated decay test (BS EN 350)

Natural durability of the wood species is classified based on the average weight loss of the test specimen compared to average weight loss of the reference species (beech) after being exposed to decaying fungi for 16 weeks [5]. The durability of wood is classified within 5 grade scale for fungal attack as in Table 2. Figure 2 shows the testing procedure of accelerated decay test by using BS EN 350 and EN 113. The X value of the species calculated can be summarized using the following formulae;

$$\text{The X value} = \frac{\text{Average corrected mass loss of test specimens}}{\text{Average mass loss of reference Specimens}}$$

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Table 2: Durability classification

Rating	Classification	X-value (EN 350)	Graveyard (Timber trade leaflet no. 28)
1	Very durable	<0.15	> 10 yrs
2	Durable	>0.15 -0.30	5-10
3	Moderately durable	>0.30 – 0.60	2-5
4	Slightly durable	>0.60 – 0.90	Not specified
5	Not durable	>0.90	< 2

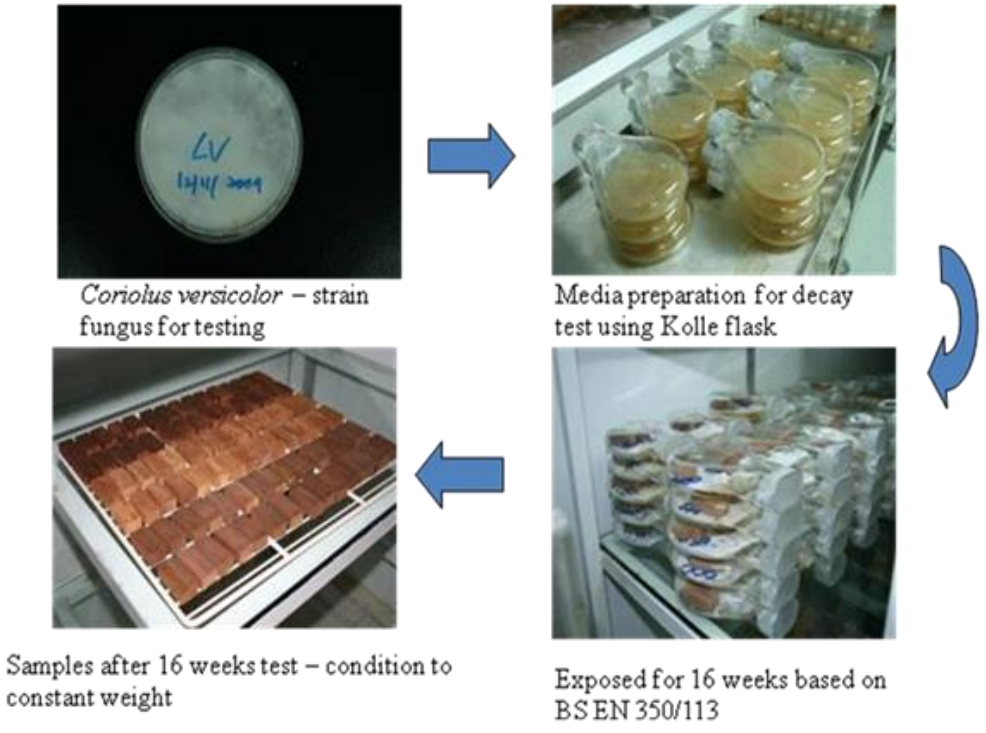

Figure 2: Accelerated decay test

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3. Results and Discussion

The durability of the tested species based on graveyard and accelerated decay test BS EN 350 is shown in Table 3. The results of graveyard test are based on previous study done by [2,3]. According to Table 3 from the eight species tested only 1 species that fall under durable class. It took about 6 years to get the results. It shows that graveyard test requires longer period (more than 3 years) to conclude the durability classes of timber species. In addition, the results may vary due to environmental factors such as the type of soil, rainfall, weathering condition which may affect the biodegradation activities on the test specimens.

According to the species tested based on BS EN 350 it shows that the durability class improve from moderately durable to durable for Meranti bukit and none durable to durable for Geronggang and kedondong species. It also shows the durability rating for each species tested. In the other hand, the test conducted only took 16 weeks to get the results supported with scientific evidence.

4. Conclusion

It is difficult to compare the results from field and laboratory tests as a greater range of wood destroying organisms are present in the field. It is important to adopt the European standard testing (BS EN 350) in order to convince the European community to accept our timber has better durability classification due to controlled environment. From the assessment it shows that accelerated decay test is more effective compared to graveyard test.

Table 3: Comparison results of graveyard and accelerated decay tests

No	Beech as a reference	BS EN 350			Graveyard	
	Species	x value	Durablity rating	Description	Avg. Service life (yrs)	Durability class
1	Binuang	0.3691	3	Mod. durable	2.5	Mod durable
2	Geronggang	0.2191	2	Durable	1.3	Non durable
3	Jelutong	0.5267	3	Mod. durable	3.5	Mod. durable
4	Kedondong	0.2984	2	Durable	1.6	Non durable
5	Kekatong	0.5133	3	Mod. durable	3.9	Mod. durable
6	Kelat	0.3420	3	Mod. durable	2.9	Mod. durable
7	Meranti bukit	0.2846	2	Durable	3.5	Mod. durable
8	Mersawa	0.2181	2	Durable	5.9	Durable

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