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Copper chrome arsenate (CCA) concentrations on absorption, penetration and retention of Tectona grandis

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ABSTRACT

The study investigated the comparative effect of Tectona grandis to different concentration level of CCA preservative. The species were obtained from five plantation trees from Burgma forest at Onigambari Forest Reserve, a total of 75 test samples consisting 60 samples treated to CCA and the remaining 15 as control experiment. The samples were later subjected to termite attack at a termittarium for 3months. The preservation absorption, retention and penetration were measured while analysis of variance was used to analyze the data. Results showed that Teak had the highest absorption, retention and penetration of 48.33km/m3 and longitudinal and lateral penetration of 4.1mm and 2.0mm at 5% concentration. The absorption of 4% concentration was 42.89kg/m3 with retention of 1.59kg/m and 47.78kg/m3 with retention of 1.40kg/m3. After exposure to termite, Tectona grandis immersed in 5% concentration of CCA produce the most durable. Analysis of variance showed a significant difference among the absorption rate while the retention shows insignificant differences among the absorption rate while the retention shows insignificant differences among the concentration. In conclusion, preservative treatment at 5% concentration produce the most durable, the higher the concentration the better the durability of Tectona grandis, hence, the treatment of the species at 5% concentrate by immersion is recommended.

Introduction

The demand for wood and wood products in Nigeria and the world over have continue to be on the increase consumption of sawn wood and wood based panels were put at 2,2,668 million m3 and 121million m3 respectively in 1993 with projection of 4704 and 236million m3 respectively by the year 2010 (FAO, 1995). According to Ogbogu (1996) more than 80% of timber products in Nigeria is utilized for constructional purposes such as doors, windows, rafters, trusses, propping beams, purlines, flooring and panels. Other important area of uses include electricity and telegraphic transmission, furniture and cabinet making, tool handles, packaging, crates, bridges, carving etc.

Wood preservation is the art of introducing toxic chemical substances into wood artificially to make the wood resist the attacks and deterioration from; biological agents, whether and fire, thus the service life of such wood can last long indefinitely. The quality of wood is determined to a large extent by the selection of trees, the care taken in cutting, seasonings and preservation. According to Walker (1993), the popular perception of timber is that it is a perishable material and that this is one its greatest disadvantage compared to other building material. Apart from termites, which are of major concern to wood users, wood decay fungi are also economic importance because of their devastating effects, leading to structural failure, reduction or outright loss of strength and mechanical properties of wood structures (Owoyemi et al.,2008).Wood therefore, remains a reliable material, so long as it is preserved from decay (Culpin,1986). The increasing importance of wood preservation in Nigeria has been highlighted by (Ifebueme and Odeyinde, 1981) this is important to wood base of the country. Unfortunately, wood preservative as an industry has not enjoyed due recognition in Nigeria. There is need therefore to take the benefits of wood preservation to uses, more so, at this stage of the country's development and period of conservation consciousness.

The need for protection and preservation of our construction and engineering timber in Nigeria coupled with the fact that many people are treating wood with little or no knowledge of timbers durability especially in rural areas inhabited by poor farmers and petty trader against wood deterioration, the need to treat wood resources from decay and insect attack has prompted this studies which will involves the use of simple and cheap treatment techniques that is steeping of cold immersion method due to the facilities at reach. Though various research and other field experiment have made it clear that pressure or vacuum method of wood treatment gives excellent and long lasting protection against wood destroying fungi, bacterial, marine-borers and fire, since the pole is having contact with the ground, but this method is not always economical and practicable as most wood users and small industries in our remote areas cannot afford expensive chemicals and treatment equipments.

The use of immersion techniques for wood treatment is very simple and can be undertaken by the average Nigeria rural dwellers even now that are enormous demands of poles for Federal Government rural electrification programme going on nationwide. The success of this study however will go a long way in recommending the concentration level of CCA preservatives for treating the small round log size of Tectona

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grandis in order to prolong its life construction and engineering works, hence reducing the frequent replacement and maintenance avoided.

Materials and Methods

The experimental samples were obtained from 5 plantation trees of Tectona grandis, felled at the Forest Research Institute of Nigeria's forest reserve at Bugma plantation. Five good and straight bole of standing dried tree of Tectona grandis trees (age=27years; DBH=60cm – 70cm) were randomly selected.

The materials of each tree selected for test were representatives of the merchantable bole of the trees, according to the ASTM (1991), standard, hence, from the sections of the tee felled bolt size of 4ft (1.2m) were taken up to the merchantable height of each tree. These bolts were then transported to the sawmill division of the Forestry Research Institute of Nigeria, at (Industrial development Unit IDU), Ibadan for processing and conversion

Processing and treatment

Bolts were sawn removing centre plank of 2.5inches. After the samples had been converted and processed, the test samples were cut into 20mm x 20mm x 300mm dimension. 15samples were selected randomly for each treatment making a total of 75 samples, including 15samples as control.

A Gallen Kamp oven was used for wood moisture content determination the test samples were conditioned to 12.0% M.C. These test samples were numbered and weighed with beam balance before and after treatment to different CCA concentration levels. The samples were treated for 24hrs in a Celcure k33 preservative, at 3different preservative concentration of 3.0%, 4.0% and 5.0%, the absorption, penetration and retention was investigated. The absorption index was expressed as an average mass per unit volume of wood samples (g/cm^3) (Akinyemi et al., 2004) .The chemical retention was determined based on the volume of chemical absorbed by the test samples in cubic meters.

Field Test: Exposure to Termite Attack

The remaining 45test samples (after removing 5 samples each for penetration) levels were left to fix for 7days after which they were taken along with controls [15 untreated samples] to an active Termite mound. The 45 samples were inserted 20cm below the mound for 3months. The test samples were assessed at the end of 3months exposure period using the visual aid rating and mass differences.

The data obtained were subjected and analyzed using the visual descriptive method and analyses of variance (ANOVA).

Results and Discussion

It was observed in Table 1 that the rate of preservative absorption was $48.89kg/m^3$ for 5.0%, 4.0% and 3.0% concentrations respectively similarly, the chemical retention level was $2.42kg/m^3$, $1.59kg/m^3$ and $1.40kg/m^3$ respectively for 5.0%, 4.0% and 3.0% concentration level.

Table 2 ANOVA Table For Retention

Source of variation	Df	SS	MSS	Fcal	Ftab
Treatment [Conc. Levels]	2	113.75	56.88	0.9822	3.23
Error	36	37.36	57.91		
Total	38	151.11			

Analysis of variance shows that there is no significant difference in the retention in all treatments (table 2) which agrees with Adejoba, (1997) who recorded an insignificant variation in the retention levels of Gmelina. The longitudinal penetration is greater than lateral penetration; this conforms with the submission of Dinwodie (1981).

Table 3. Summary of the visual assessment of exposed samples

Samples	Termite attack	Depreciations	Mass loss
3.0%CCA	Slight and Sound	96.15	6.89
4.0%CCA	Slight but + ve & sound	98.08	6.35
5.0%CCA	Sound	100	5.62
Control	Failure	26	67

It is evident that the 5.0% concentration was sound after exposure however; there was not much difference with other concentration levels.

Conclusion and Recommendation

This study was geared towards knowing the importance of different concentration level of preservative on preservation of small round log for farm structures, cross arms and transmission poles. This is important because the success will go a long way in providing a known and suitable chemical concentration levels for structures and any engineering work especially in rural area of Nigeria where pressure treatment plant are hard to come by, now that naturally durable wood species are becoming increasingly scarce from the forest.

The following conclusion can be drafted:

1. Absorption retention, and penetration increased as the concentration level of preservative were increased in cold immersion.
2. The most efficient concentration level of CCA was obtained at 5% concentration level and its shows the most durable on Tectona grandis under field test, however, higher, concentration of CCA preservative will give a total insulation against agents.

Based on the result the following recommendations were made;

1. Tectona grandis should be treated at 5%, 4% and 3% concentration level of CCA preservative for outdoor use each as for structures however; in terms of longer durability 5% concentration is preferred.
2. Legislation against indiscriminate felling of immature Teak from forest reserve should be discouraged and trees should be preserved before use.
3. Further investigation should be carried out on the treatability of Tectona grandis

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Table 1. Average preservative absorption, retention and penetration of tectona grandis.

Concentration	Absorption (kg/m^3)	Retention (kg/m^3)	penetration mm Long.	Lat.
3.0%CCA	47.78	1.40	3.0	2.0
4.0%CCA	42.89	1.59	3.2	2.0
5.0%CCA	48.33	2.42	4.1	2.0

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