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Effect of Incision on Preservative Absorption Capacity of *Gmelina arborea* Wood

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Abstract: The effect of incision on preservative absorption capacity of *Gmelina arborea* wood was investigated using Copper Chrome Arsenate (CCA), creosote oil and Cashew Nut Shell Liquid (CNSL) preservatives. The result revealed that incising improved the uptake of the preservatives by the wood with a percentage absorption of 9.44±3.28 compared with unincised; 7.83±2.96. Using 555 incisions m^{-2} to an incision depth of 5 mm statistically showed significant difference between incised and unincised treatments. Also, there was significant difference between CCA and the other two preservatives in the absorption capacity of *Gmelina arborea* wood. The highest percentage absorption 13.60±1.91 was recorded for CCA, followed by creosote oil 7.8±0.66, while CNSL has the least absorption 6.92±0.80.

Key words: *Gmelina arborea*, copper chrome arsenate, creosote oil, cashew nut shell liquid, incision

INTRODUCTION

The increasing realisation of the fact that wood is prone to degrading factors such as decay, insect and fire had necessitated the use of preservative treatments to prolong its serviceable life, especially when such wood is used outdoors. Recent initiatives tend to assert however that the effectiveness of wood preservatives treatment is not only a function of the toxicity and repellent nature of the preservatives alone but also that of pre-treatment processing and methods of application. One of such treatments being proposed is incision method (Nami *et al*., 2002; Hernandez and Winandy, 2005).

In southwestern Nigeria, *Gmelina arborea* Roxb. wood is commonly available, but has limited use for exterior job because of its susceptibility to termites attack. Ifebueme *et al*. (1990) asserted that the heartwood of *Gmelina arborea* wood is resistant to penetration by preservatives, it has a medium specific gravity of 0.47 which ranges from 0.40 to 0.54, large diameter vessels of 30 to 65 per 10 m^2 axial parenchyma cells that are predominantly associated with vessels and multi-serrated rays of 4 to 10 cells wide as well as the thin walled fibers and tracheids which account for penetrating the sapwood of this species with water-borne and oily preservatives.

However, recent initiatives have now revealed that the dry heartwood is resistant to penetration by both water-borne and oily preservatives even when treated with vacuum pressure and hot treatment methods. Deposition of extraneous materials in the wood cell walls and in the lumens during the biochemical transformation of the sapwood into heartwood, encrustation of the pit membrane surface as well as the in-growth of obstructing tyloses into the vessels are mainly responsible for little preservative flow in the wood. It is thought that the use of mechanical incision could improve the amount of end grain that is exposed during preservative treatments.

This study therefore investigated how the preservative absorption capacity of *Gmelina arborea* wood could be enhanced through incision.

MATERIALS AND METHODS

Freshly sawn *Gmelina arborea* wood samples obtained from The Forestry Plantation of the Federal University of Technology Akure, Ondo State Nigeria (Lat. 7°17'N, Long 5°10'E, Tropical Rainforest Zone, Mean Annual Temperature 28°C; elevation 350 m) were cut (flat sawn) into thirty pieces of 300×38×38 mm. The weight of the samples were taken before oven drying and recorded as T_1. The samples were oven dried at 105°C for 24 h to remove the moisture. The weight of the samples were taken and recorded as T_2. Fifteen of these samples were incised using mechanical incisor of 555 incisions m^{-2} to an incision depth of 5 mm. The other fifteen samples, which were unincised served as control.

After incising, five samples each were cold dipped in CCA, creosote oil and CNSL preservatives, respectively for 24 h, respectively. The unincised samples which served as control were also cold dipped in the preservatives for 24 h. The incised and unincised specimens were withdrawn from the tank and drained on

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wire mesh after which the samples were weighed again and recorded as T_3. The preservative absorption was calculated using the weight of samples before and after preservative treatments:

$$\text{Absorption \%} = 100\,(T_3 - T_2)/T_2$$

Where:
T_3 = Treated weight
T_2 = Oven dry weight

The cumulative percentage of each chemical preservative as determined by relative net uptake was subjected to statistical analysis, which include descriptive statistics (mean) and two-way analysis of variance (randomized CBD). Mean difference where significant difference existed was done with Fisher's Least Significant Difference (LSD).

RESULTS AND DISCUSSION

The result of mean percentage absorption of preservatives by incised and unincised *Gmelina arborea* presented in Table 1 showed that CCA has the highest absorption with 13.6 and 10.1%, for both incised and unincised samples when compared with Creosote oil and CNSL treatments. This was followed by creosote oil with 7.8 and 7.3%; while CNSL has the least with 6.9 and 6.1%, respectively (Fig. 1). The result also revealed that there is increase in the quantity of preservative absorbed by *Gmelina* wood for incised treatments than for the unincised (Table 1).

The analysis of variance showed that there were significant differences in the preservatives and also in the pre-treatment methods (Table 2). Also, the follow up test, at least significance difference value of $p>0.05$ (Table 1), showed that there were significant differences between CCA and the other two preservatives; Creosote oil and CNSL, thus indicating that the type of preservatives used affected the quantity absorbed by the wood. CCA treatment was significantly different from Creosote oil and CNSL preservatives while there were no significant differences between Creosote oil and CNSL preservatives; this tend to indicate that the nature of preservative determined the quantity that would be absorbed. The average uptake (13.60±1.91; 10.12±2.18) in the samples to a depth of 5 mm, was greater for CCA treatment than for creosote oil and CNSL.

Incising improved the uptake of the treatment preservatives compared with the uptake in unincised samples (Table 3). Incised Gmelina samples have the higher mean percentage absorption (9.44±3.28) than for the unincised samples (7.83±2.96). The analysis of variance showed that the difference was statistically different at $p>0.05$ levels.

The results showed that absorption was highest for CCA. Creosote oil and CNSL were lower because of their oily nature. The hygroscopic nature of wood makes it easily permeable to waterborne preservatives than oil borne. This agrees with the previous assertion of Anonymous (1974) that absorptions are higher for water

Table 1: The mean percentage absorption of preservatives in incised and unincised *Gmelina arborea* wood

	Mean % preservative absorption*	
Preservatives	Incised	Unincised
CCA	13.60±1.91a	10.12±2.18a
Creosote	7.80±0.66b	7.26±2.31b
CNSL	6.92±0.80b	6.12±3.15b

*Means with the same letter(s) vertically are not significantly different. ($p>0.05$)

Table 2: Percentage absorption of preservative types and method of application in *Gmelina arborea* wood

Source of variation	DF	SS	MS	f-cal	Significant level
Methods	1	19.36	19.36	4.49	0.044*
Preservatives	2	160.95	80.47	18.66	0.000*
Error	26	112.12	4.31		
Total	29	292.43			

Table 3: Mean percentage Absorption for incised and unincised treatments in *Gmelina arborea* wood

Methods	Mean % absorption*
Incised	9.44±3.28a
Unincised	7.83±2.96b

*Means with the same letter(s) vertically are not significantly different. ($p>0.05$)

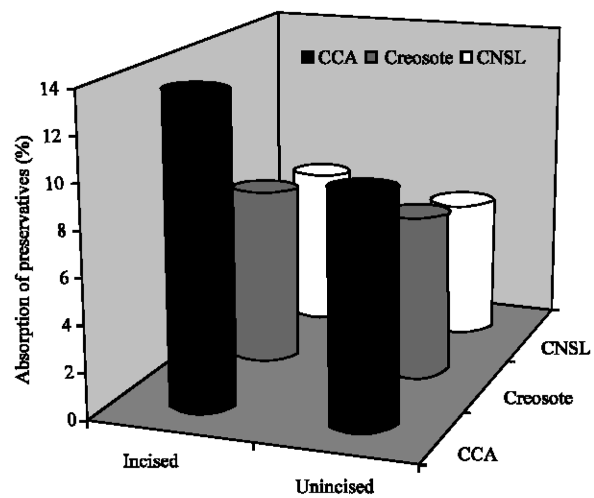

Fig. 1: Comparison of incised and unincised *Gmelina* treated woods

soluble preservatives than for oily types, because water does not only fill the cell cavities but it is also absorbed in the cell walls. Thus, CCA that is water base would readily be absorbed into the cell lumen as well as the cell walls, while Creosote Oil and CNSL would only fill the cell lumen because of their high viscosity.

Incising had relatively little effect on the quantity of Creosote oil and CNSL preservatives absorbed because of their higher viscosity (Table 1). However, doubling the incision depth might increase the in flow and penetrations of preservatives thereby enhance absorption. This agreed with the previous findings of Lebow and Morell (1993) on *Douglas fir*.

In conclusion, incising treatment increased the penetration and inner assay zone of *Gmelina arborea* for CCA, Creosote oil and CNSL preservatives absorption. Although this study did not examine the effect of varied incising depths on the absorption because of the negative effects the rupturing of the fibers will have on mechanical properties of the wood, further studies are being planned to explore the potential for increasing incising depth without serous effect on the mechanical properties of the wood.

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