Journal Of Tropical Forest Resources.

ISSN 0189 - 3130
VOLUME 16(1) 2000

J. Trop. For. Resources Vol. 16.1 (2000): 66-71

PRELIMINARY STUDY ON USE OF ENGINE OIL AS WOOD PRESERVATIVE

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ABSTRACT

Test samples of *Ceiba pentandra* Linn, *Antiaris africana* Engl and *Triplochiton Scleroxylon K. schum* were treated with spent and new engine oil (SAE40). Three methods of preservative application used are brushing and soaking for 24 hours and 48 hours .The absorption per unit volume of the wood were evaluated. The static bending strength and stiffness values of samples soaked in used engine oil for 48 hours were also obtained. The highest mean absorption rate per unit volume recorded in the study were 30.20kg/m³ for *Triplochiton scleroxylon*,_and 39.20 kg/m³ for both *Ceiba pentandra* and *Antiaris africana* when soaked in new engine oil for 48 hours. The least mean absorption rate of 15.80 kg/m³ 19.80kg/m³' and 20.00kg/m³were recorded for *Triplochiton scleroxylon*, *Antiaris africana* and *Ceiba pentandra* respectively. Following used engine oil application by the brushing method. Statistical analysis carried out showed that both the species and methods of preservative application are significant factors to consider in determining the absorption rate per unit volume of the wood samples. Test results further showed that the engine oil used as the preservative oil had no significant effect on the bending strength of the treated wood samples.

INTRODUCTION

Wood as a natural fibrous material produced by tree was one of the first structural materials discovered by man. It exhibits a lot of variations in properties in terms of durability, strength, figure, density and grain (George 1975). Due to this diversity in character, exploitation was selective and was limited to the very strong and durable species such as *Melicia excelsa Khaya ivorensis, Afzelia africana, Nauclea diderrichii* etc (Ifebueme 1977). The over exploitation of these species led to their scarcity with subsequent introduction into the market many lesser-known species which are less durable and sometimes highly susceptible to biodeterioration.

The discipline of wood preservation is not a novel concept having been in existence for many centuries. In the past, various methods have been adopted at preserving wood, and now wood preservation has found acceptance in many aspects of wood utilisation (Richardson 1978). Although preservation of wood requires an additional cost, but for various advantages of wood for structural application, chemicals impregnation directed at prolonging premature fibre loss in wood may be justified. Published studies have revealed that, various chemicals and methods of their application have been adopted over the long history of wood usage by man (Ifebueme 1977, Dinwoodie 1989). In Nigeria, due to the drift in the national economy, wood users have been adopting different strategies to beat the hardship by using different types of preservatives that could be sourced locally for treating wood (Adetogun 1998). It is in the light of this that the present study was embarked on with the aim of evaluating the potentials of preserving wood with spent lubrication oil (SAE40). The first part of this report presents the results of the findings on the effect of the treatment on the properties and rate of preservative absorption into the wood samples

MATERIALS AND METHODS

The study was designed to evaluate some experimental factors and variables. Three non-durable species obtained from a local timber market were used as test samples: *Triplochiton Scleroxylon (Obeche), Ceiba pentandra (Araba)* and *Antiaris africana (Antiaris).* The preservative comprised of both spent and unused lubricating oil. The used engine oil (of the same brand with the new engine oil) was in service for 92 days while the new oil was procured from the filling station with specification SAE 40.

The wood materials with mean moisture content of 45-58 percent were air-dried for 7 weeks until average moisture content of about 17 percent was attained. A total of 128 test samples were prepared from each species in accordance with ASTM D-198-67. Test samples of each species were properly stacked out, out of which ten (10) representative samples of each species were randomly selected and used for moisture content determination. Using the oven dry method, the percentage moisture content of the test samples was determined.

Apart from the wood species (3) and types of engine oil (2) already mentioned above, the remaining experimental factor examined in the study is method of preservative application-brushing, soaking for 24 and 48 hours. These factors produced 18 treatment combinations. Ten replicates were made for each treatment combination thus giving a total of 180 test samples for the study. The test samples were weighed before preservative application and re-weighed after preservative application. Based on the difference in weight before and after immersion, the absorption per unit volume (kg/m^3) for each of the test samples was determined. Ten representative treated samples were randomly selected from each species lot for the purpose of evaluating the effects of the treating oil on their strength properties. Test samples were subjected to bending tests using Hounsfield Tensomenter machine. The Moduli of Rupture (MOR) and Elasticity (MOE) were calculated from the test readings obtained for both treated and control test samples. The bending test procedure was in accordance with the ASTM D - 198 - 67.

RESULTS AND DISCUSSION

Table 1 presents the results of the mean absorption rate per unit volume (kg/m^3) obtained from the sampled materials. Also the results of the statistical analysis of variance (ANOVA) carried out are presented in Table 2.

Table 1: Mean Absorption rate per Unit Volume (kg/m^3) for the treated wood samples

Species	New Oil			Used oil		
	Brush	24Hrs	48Hrs	Brush	24Hrs	48Hrs
Araba	20.40	36.80	39.20	20.00	36.60	38.60
Antiaris	20.00	36.80	39.20	19.80	36.00	39.00
Obeche	16.20	28.00	30.20	15.80	27.40	29.80

As shown in table one, there were negligible increases in the mean absorption per unit volume of the wood samples treated with used and new engine oil for same wood species and the type of treatment method. For brush method, the increases ranged from 1 to 2% for the three wood species. For the 24 and 48 hours soak methods, the increases were similarly as low as 1 to 4% and 1 to 3% respectively. Regardless of wood species and method of application, the mean absorption value of 29.7kg/m^3 in wood samples treated with new engine oil were not significantly different at 5% probability than the mean value of 29.20kg/m^3 obtained in samples treated with used engine oil.

As for species effect, the rate of absorption of the used or new oil into the treated wood samples was similar for Araba and Antiaris considering similar method of application. For each of the two types of preservatives same or slightly varied mean absorption values were recorded under same treatment method. The response of Obeche to penetration by the types of preservatives was somehow different from those observed for Araba and Antiaris. For treatment with new engine oil, mean absorption value for this species were substantially lower by about 14 to 24% while they were about 20 to 25% for the spent engine oil among the three methods of application.

Regardless of type of oil and method of application the mean absorption value of 31.9kg/m^3 that originate from Araba test specimens were not significantly different at 5% level of probability than mean value of 31.8kg/m^3 obtained from Antiaris test specimens. Each of these means values of 31.9kg/m^3 and 31.8kg/m^3 was however found to be significantly higher at 5% level of probability than the mean value of 24.9kg/m^3 obtained from Obeche test specimens.

The wide range in the absorption per unit volume for the treatment combinations may be linked to some of the evaluated factors such as wood species and preservative application methods. As reported in literature wood anatomical structures exhibit a lot of influence on the absorption and retention per unit volume of wood preservatives (Wenlong *et. al.*1997). Similarly preservative application method is indicated to exhibit a significant effect on the absorption and retention per unit volume of chemical preservative used (Ifebueme 1985, Alscher *et. al.* 1989).

For each wood species and type of preservative, the mean absorption values obtained from the treated test specimens were substantially lower for the brushing method when compared to 24 and

48 hours soak method. The difference in the results between soaking for 24 and 48 hours for the same wood species and preservative oil were not as pronounced as those between brush and 24 hours. Regardless of wood species and type of preservative oil, the mean absorption value of 18.7kg/m³ obtained for test specimens treated via the brushing method was significantly lower at 5% level of probability than the mean of 33.6kg/m³ and 36.0kg/m³ obtained for specimens treated via the 24 and 48 hours soak respectively.

Table 2: Result of the analysis of variance test (ANOVA) for the absorption per unit volume as influenced by the experimental factors applied in the study

Source of Variance	D.F.	S.S.	M.S.	F-value
Species A	2	2132.13	1066.07	253.23**
Method B	2	10541.2	5270.6	1251.96**
Type of Oil, C	1	8.02	8.02	1.96ns
AB	4	213.07	53.27	12.65**
AC	2	0.045	0.03	0.01ns
BC	2	0.310	0.16	0.04 ns
ABC	4	1.40	0.35	0.09 ns
Error	162	682.0	4.21	
Total	179	13578.20		

** = Highly significant at 0.01 level of significance.
ns = not - significant at 0.05 level of significance.

The results of the ANOVA carried out on the test data revealed that both wood species and method of preservative application have significant effect at 1% level of probability on the absorption per unit volume of the treated samples. Similarly, the interaction between the wood species and preservative application method was significant at the same level of probability. In contrast, the type of engine oil used in the study and its two-way and three-way interaction with the other variables were not significant.

Published works indicated that absorption rate and retention per unit volume exhibited significant influence on the life span or durability of treated wood samples. Dinwoodie (1989) and Wenlong *et. al.* (1997) reported that high absorption and retention rate performed better in terms of durability when compared with less absorption rate. It should also be noted that the range of values recorded for absorption rate in this study is low compared to those reported by Ifebueme (1985) and Wenlong et. al. (1997) for conventional water borne preservatives such as CCA. This could however be linked with the high viscosity of engine oil compared to water borne preservatives.

Table 3 presents the mean test values for the static bending properties of both the treated and control wood samples while Table 4 presents the results of t-test analysis, which compares the data that emanated from the treated, and control samples.

Table 3. Mean Test Result for the Bending Properties (N/mm^2) of the Treated and Control Wood Samples

	Treated*		Control	
Species	MOR	MOE	MOR	MOE
Araba	38.34	3280	38.64	3264
Antiaris	68.16	5014	69.23	5005
Obeche	72.08	5218	72.12	5210

*: Treated samples were soaked in used engine oil for 48hrs.

Table 4. T-Test result comparing the difference between the bending properties of the treated samples

Samples	Variable	Treated	Control	t-value
Araba	$\overline{X}$	38.34	38.64	0.1^{ns}
	N	10	10	
	S^2	6.25	8.22	
Antiaris	$\overline{X}$	68.16	69.23	0.23^{ns}
	N	10	10	
	S^2	2.30	2.51	
Obeche	$\overline{X}$	72.08	72.12	0.04^{ns}
	N	10	10	
	S2	3.72	3.85	

ns = not significant at 0.05 level of significance

From Table 3, the mean MOR values obtained for the treated and the control specimens of Araba species are 38.34N/mm² and 38.64 N/mm² respectively. Mean value of treated specimens of Antiaris is 68.16N/mm² as against 68.23N/mm² for control samples. Also a mean value of 72. 08N/mm² was recorded for treated Obeche while 72.12N/mm² was recorded for its control samples. As shown in Table 3 soaking of wood test specimens in used engine oil for 48 hours prior to testing had no effect on their static bending strength. If anything the mean values of the treated test specimens decreased by 0.8%, 1.6% and 0.06% from figures recorded for their control counterparts in Araba, Antiaris and Obeche respectively. No significant difference at 5% level of probability was found between the treated and control results.

MOE values as obtained, were 3280, 5014 and 5218N/mm² for treated samples and 3264, 5005 and 5210N/mm² for control samples in Araba, Antiaris and Obeche respectively. Contrary to what was obtained for the MOR values, the stiffness results indicated that the MOE values of the treated test specimens were marginally higher by 0.5%, 0.002% and 0.002% in the treated samples than in the results obtained for their control counterparts in the wood species. For the low values of these increases, no significant difference was found at 5% level of probability between the treated and control MOE data.

CONCLUSIONS

From the results of the present work investigated in this study and the subsequent statistical analysis carried out, the following conclusions are drawn:

1. It is technically feasible to impregnate non-durable wood species with both spent and new lubricating oils using non-pressure preservative treatment method.
2. It is also evident from this study that the absorption of preservative oil per unit volume of wood may be influenced by the species and method of application of the preservative.
3. Although not statistically significant, the absorption rate of the sampled species is generally lower with spent lubricating oil than unspent engine oil.
4. It is demonstrated in the study that the application of preservative oil into the wood samples has no detrimental effect on their strength and stiffness..
5. Since both spent and new engine compared well in terms of absorption and penetration, it thus makes economic sense to use spent engine oil for wood treatment.

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