NOTE

TREATMENT OF *GMELINA ARBOREA* WITH CCA USING THERMAL PROCESS

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Gmelina arborea was originally established in Nigeria for the supply of pulp wood to the country's pulp and paper mills (Akachukwu 1993). However, this objective has not been achieved. The pulp and paper industries in the country have all closed down and *G. arborea* is now used for building. Most of the standing trees in plantations have grown beyond their rotation ages for pulpwood supply and steadily matured to saw log dimensions suitable for construction timbers. These plantations are now ready sources of saw logs for conversion into sawn wood of uniform grades and sizes.

Gmelina arborea is moderately durable with a service life of less than 15 years (Salim *et al.* 2002). To improve its service life as construction timber, this species requires mandatory treatment with chemical preservatives. The heartwood of *G. arborea* logs kept under cold storage for a period of one year contains very high moisture content of close to 45% (Badejo 1977). Low moisture levels below the fibre saturation point (25–30%) are required for effective treatment of wood. Wood preservation is concerned with eliminating or controlling the basic needs of fungal organisms. The efficacy of wood preservatives depends on a number of factors including the extent to which toxic chemicals penetrate wood substrate. Current wood preservation techniques in Nigeria are limited to the use of brushing to coat logs, sawn planks and rafters with engine oil, solignum, which at high temperature will bleed out of the wood.

Chromated copper arsenate (CCA) mixtures have been shown to offer good protection to soft woods over long periods of service, being highly effective against both fungal decay and insect attack. Copper is particularly effective against soft rot fungi, arsenic is an insecticide and provides protection against copper tolerant fungi, and chromium helps fix chemicals thereby reducing preservative leaching from wood. Effective treatment of wood with CCA depends on the amount of penetration, retention and degree of fixation of CCA in wood. Good penetration of CCA can be achieved at higher temperature since the viscosity of water is about 0.1 poise at 20 °C and decreases to 0.055 poise at 50 °C (Walker *et al.* 1993). CCA is widely used in Nigeria but because most wood users in the country do not have access to vacuum or pressure treatment cylinders, the preservative is applied by immersion.

The focus of this study was to examine the absorption, salt retention and penetration of CCA in wood samples of *G. arborea* at different preservative treating temperatures. Plantation-grown *G. arborea* wood samples measuring 25 × 15 × 50 mm were dried in an oven at 103 °C for 18 hours to constant weight. This is to minimize the moisture content so as not to reduce the concentration of the preservative when used on the wood. The wood samples were then treated in accordance to the local standard concentration of 3% (w/v) CCA at one of five temperature regimes, namely, 28, 41, 54, 67 and 80 °C using hot and cold immersion methods at one-hour intervals. CCA is a water borne preservative which is less viscous when compared with oil-borne preservatives, hence, heating the solution for a longer period will lead to evaporation of the solvent. The sizes of the test blocks also determine the soaking period. However, for full length lodge poles the soaking period in hot bath may be up to six hours and in cold bath, two hours.

Determination of chemical absorption was calculated as the difference between weight after and before treatment. The absorption, expressed as an average weight per unit volume of sample, was calculated using the formula below:

$$\text{Absorption} = \frac{\text{Total absorption} \times \text{concentration of CCA}}{\text{Volume of wood sample (m}^3) \times \text{no. of pieces}}\ \text{kg/m}^3 \quad (1)$$

Net dry salt retention indicates the amount of toxic ingredient taken up by timbers treated with preservative. Alternatively, it is the amount of toxic ingredient fixed in the wood after treatment. Determination of net dry salt retention was based on the volume of chemical absorption by test samples and was calculated using the formula below:

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$$\text{Retention} = \frac{\text{Weight of chemical absorbed} \times \text{concentration of solution}}{\text{Volume of wood pieces}} \text{ kg/m}^3 \quad (2)$$

Ten samples of treated *G. arborea* from each of the treatment temperature were taken and cut longitudinally so as to determine the longitudinal and lateral penetrations of preservative into the wood. A colour indicator, rubeanic acid, was applied to the cut surfaces of samples. The depth of penetration was determined using a metric ruler.

Mean absorption, dry salt retention and penetration of CCA in *G. arborea* were significantly different (p = 0.05) when treated at different temperature regimes (Table 1). Mean absorption of wood samples ranged from 0.075 to 0.589 kg/m^3 and mean dry salt retention ranged from 0.231 to 0.319 kg/m^3. Wood samples treated at 80 °C had the highest absorption, retention of dry salt and penetration. This supports earlier researches by Anonymous (1986), Zaidon *et al.* (1998) and Ogbogu *et al.* (2000).

Application of rubeanic acid to the area of wood where CCA penetrated produced a dark greenish colour immediately after treatment. The mean radial penetration was between 2.10 and 2.70 mm. The highest CCA penetration was observed at 80 °C. It is interesting to note that the preservative at this temperature did not cause precipitation and gave a lighter greenish colour when compared with other temperature regimes. This indicated that retention per unit volume of preservative was greater at higher temperature. Viscosity of water is lower at higher temperature and this enables CCA, being a water-borne preservative, to penetrate deeper into the void spaces in wood.

Table 1 Mean radial absorption, retention and penetration by *Gmelina arborea* wood treated with CCA (3% w/v) at different temperature regimes

Temperature (°C)	No. of test specimen (kg/m^3)	Absorption/ unit volume of wood sample (kg/m^3)	Dry salt retention (kg/m^3)	Radial penetration (mm)
28	10	0.075*	0.231*	2.10*
41	10	0.077*	0.269*	2.25*
54	10	0.095*	0.284*	2.30*
67	10	0.104*	0.303*	2.40*
80	10	0.589*	0.319*	2.70*

* = significant difference at 0.05

From this study we conclude that *G. arborea* can be easily treated with CCA using hot and cold immersion methods, with the best results achieved at 80 °C. Although, heating CCA at higher temperature can lead to surface precipitation, however, this was not observed in this particular species. This study, therefore, provides a method for successful treatment of *G. arborea* with CCA preservative to allow the use of this species in construction works, namely, as rafters and purlins in roof trusses, as well as for production of doors and window frames.

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