Research Journal of Applied Sciences 4 (5): 157-159, 2009
ISSN: 1815-932X

Utilization Potentials of *Eucalyptus grandis* (Hill ex Maiden) a Municipal Tree on the University of Ibadan Campus

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Abstract: Selected physical and mechanical properties of 28 years old *Eucalyptus grandis* planted as municipal trees were evaluated to determine its utilization potentials. Five trees were selected and felled. Test samples were then taken at four different levels along the bole. The properties of the wood evaluated were moisture contents, calorific energy, impact and static bending properties. Data collected were statistically analysed using ANOVA. Statistical analysis of the results showed significant variation in the calorific energy properties, impact and static bending (MOR and MOE) along the bole of *Eucalyptus grandis*. Moisture content however, showed a level of axial uniformity. All the results of the test carried out showed that Eucalyptus grandis is a very strong wood species, which can be used for load bearing work in construction such as flooring and paneling. Due to the high calorific energy values recorded in this study off cuts of this wood have great potentials for fuel wood and charcoal production.

Key words: *Eucalyptus grandis*, moisture content, calorific energy, properties, municipal, environment

INTRODUCTION

Municipal trees refers to those trees found in urban centers and also trees found in the smallest village, i.e. it includes not only trees found in the city limits, but trees found in associated lands that contribute to the environment of populated places. The presence of these trees have different uses and where planted to beautify the environment, enhance environmental conditions and also when felled the trees have utilization potentials especially when they reach timber size. When felled, some municipal trees can be used as timber for construction, fuel wood, pulp and paper production etc. All the utilization potentials to be identified are aimed to reduce biomass waste, which occurs when these trees are not properly utilized.

In most developing countries, importance of municipal trees management has not given the desired recognition and this is a major set back, because urban trees have several utilization potentials as standing trees and when felled as timber and this can reduce cost of production of wooden materials. This study is designed to investigate the utilization potentials of *Eucalyptus grandis* Hill ex Maiden, which is being used as an avenue tree in the University of Ibadan campus.

Eucalyptus, today is one alternative to preserve nature, since it is a fast growing tree and due to its easy adaptation, the tree has become a good rational alternative against native forest devastation (Walker *et al*., 1993). Eucalyptus can be used as lumber, moulding and mill work, sliced and rotary peeled veneer, plywood, composite panels, flooring, furniture, engineered wood products (Bradstock, 1981). Coppen (2002) is of the view that eucalyptus can be used to remove effluent, which is generated by industries, some industries plant these trees to help in waste management, because of the plant's effluent disposal characteristics, this helps in reducing pollution. Eucalyptus because of their use in the abatement of pollution is planted as avenue trees also. Although, the different species of eucalyptus and their uses/utilization potentials, have been documented by researchers in area of wood quality most of the works are based on plantation species with limited efforts on those planted as avenue trees. The main objective of this study is to investigate the utilization potentials of *Eucalyptus grandis* found in the University of Ibadan Campus through the determination of the physical and mechanical properties of the wood.

MATERIALS AND METHODS

Five trees of *Eucalyptus grandis* with an average height of 15 m were felled from a live fence at the Department Of Forest Resources Management, University of Ibadan situated at latitude 7°26'N and 3°54'E in Ibadan, Nigeria. The trees were crosscut into four 50 cm billets,

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which represent the different height levels, on which the experiment was carried out. Test samples were selected from both the sapwood and heartwood regions of the wood. Test panels of different dimensions were then prepared from each billet.

Moisture content determination: Ten test samples of 2×2×2 cm were randomly selected from each of the four different height levels. The test samples were weighed to determine the initial weight after which they were oven dried in the oven at 103°C for 18 h, until a constant weight is obtained. The weights obtained were considered as final weights. The moisture content was determined using the equation (BS 373, 1957):

On dry basis:

$$Mc = \frac{\text{Initial weight} - \text{Final weight}}{\text{Final weight}} \times 100$$

Where,
Mc = Moisture content

Calorific value determination: Another set of ten test samples of 2×2×2 cm randomly selected from each of the four different height levels were pulverized using a hammer mill. The energy content was determined in accordance with ASTM D143-94 standard test methods for analysis of wood fuel (ASTM, 2007).

Impact bending: Test panels of 2×2×30 cm were prepared from each height level for the impact bending test. The test was carried out on a modified Halt turner impact machine. The hammer/load was made to drop at the centre of the test sample. Initially, the height of drop was increased at rate of 5.0 cm. This continued until the specimen failed. The height at which the specimen failed was recorded and this indicates the maximum level of resistance to sudden applied force of the specimens (BS 373, 1957).

Static bending: The test specimen was of the dimension of 2×2×30 cm. The machine used for the test is the Hounsfied Tensometer. Each test samples was supported over a span of 30 cm a Hounsfied Tensometer testing machine. The load was applied to the centre of the specimen of a constant speed of 0.11 m m^{-1}, until failure of the test piece occurred. An extensometer was attached to produce a load deflection graph was plotted simultaneously as the test was in progress. The corresponding deflection up to the proportional limit this procedure was repeated for all the test specimens (BS 373, 1957).

The results obtained were used to determine the Modulus of Rupture and Modulus of Elasticity of the test specimens.

The Modulus of Rupture was calculated using the equation:

$$MOR = \frac{3PL}{2bh^2}$$

Where,
P = Maximum load (N)
L = Span in centimetre
b = Breath in centimetre
h = Depth in centimetre

While, the Modulus of Elasticity was determined by:

$$MOE = \frac{P_1 L^3}{4\Delta 1 bh^3}$$

Where,
P_1 = Load (N)
Δ_1 = Deflection of mid point corresponding to the load P_1. This was calculated form the load deflection diagram was plotted during testing
L = Span in centimetre
b = Breath in centimetre
h = Depth in centimeter

RESULTS AND DISCUSSION

Table 1 shows, the mean values of the parameters determined at different height levels in the study. The mean moisture content ranged from 28.56-32.65%. The result shows a decrease from butt to top. The variations observed in the moisture content at the different height levels are responsible for the variations recorded in the strength properties. According to Kollman and Cote (1968) decreased in moisture content below fibre saturation point leads to corresponding increase in the strength properties of a given timber.

The values of the calorific energy ranged from 3.92-4.49 kcal m^{-3}. The calorific energy values were significantly different (>0.05) within the height levels and the bark. The high calorific energy value observed in the butt was as a result of large volume of wood contained in this level. Incidentally, the bark produced more energy than the top, the presence of extractives within the bark could be responsible for this.

The result of the IMB shows a decrease from butt to top. The mean values of the IMB ranged from 32.33-47.67. The anatomical effects of cell length, S_2 microfibrillar angle, ring width and earlywood: latewood ratio could account for differences (Eaton and Hale, 1993).

Table 1: Average values of moisture content, calorific energy and strength properties of *Eucalyptus grandis* at different height levels

Properties	Top	Middle	Above dbh	Butt	Bark
Moisture content	29.67	32.65	28.56	30.14	-
Calorific energy (kcal m^{-3})	3.92	3.99	4.25	4.49	3.95
Impact bending	32.33	34.00	36.92	47.67	-
Static bending					
MOR (N mm^{-2})	45.83	55.00	68.75	74.58	-
MOE (Nm mm^{-2})	425.78	567.16	575.27	827.73	-

Dinwoodie (2000) also, noted that knots themselves contribute considerably to a reduction in strength dependent on their size, number and distribution in relation to beam edges and clustering. All these could be responsible for the results obtained in the present study. The variation in the strength properties at different height levels observed in this study is in consonance with the research of Shukla *et al*. (1989). Barnes (1990) also observed that anatomical properties, moisture content, physical and mechanical properties are the major causes of variations in wood.

The mean values of MOR ranged from 45.83-74.58 N mm^{-2}. The decreased of MOR from butt to top as observed in this study was in consonance with the works of Kollman and Cote (1968) and Shukla *et al*. (1989) observed that as sampling position of tree moves from butt to top the MOR decreases. Moreover, the fibre morphological characteristics as well as defects such as knots found in the upper region of a tree would determine it's bending properties.

The same trend of decrease was observed in MOE. The values ranged from 425.78-827.73 N mm^{-2}. The reduction in MOE at the top, which is in the crown region is due to the presence of knots, which in general, have a greater effect on strength (Shukla *et al*., 1989; Shupe *et al*., 1997).

CONCLUSION

In conclusion, the study also revealed significant differences within the height levels among all the parameters tested (>0.05).

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