DE-RESERVATION, ENCROACHMENT AND DEFORESTATION: IMPLICATIONS FOR THE FUTURE OF NIGERIAN FOREST ESTATE AND CARBON EMISSION REDUCTION

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Assessment of the Strength and Sorption Properties of Nigerian made Wood Plastic Composites

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Abstract

The strength and sorption properties of Nigerian made wood plastic composites used as building components were assessed. Results obtained indicated that the composites generally had low strength values and were dimensionally stable. The wood plastic composites can only be used for non-structural purposes in both interior and exterior applications.

Introduction

Wood Plastic Composites (WPCs) consist primarily of mixtures of wood and thermoplastic polymers blended together under heat either by extrusion, compression or injection process. While wood fibres/particles serve as inexpensive fillers to increase strength and stiffness of composites or to reduce raw materials costs, thermoplastic polymers enhance the surface hardness, improve the dimensional stability by reducing the affinity for water swelling and reduce the susceptibility of the wood to biological degradation (Younquist, 1999; Smith, 2001). Additives are added in small amounts to enhance properties. For example, lubricants improve surface appearance and processing; coupling agents improve adhesion between the wood and plastic components. Other possible additives include colorants, light stabilizers, foaming agents, etc. (Verhey and Laks, 2002)

The main applications of WPCs are in products such as rails, decking, door and window profiles, decorative trims, roof tiles, sheathings etc. New applications and end uses of wood plastic composites include decking, flooring and outdoor facilities, window frames etc. with improved thermal and creep performance compared with unfilled plastics (English and Falk 1995, Tangram Technology, 2002; Verhey et al., 2002).

These composites are also gaining acceptance in automotive, industrial and marine applications (Bledzki and Gassan, 1999). Although the WPC industry is still only a fraction of a percent of the total wood products industry, it has made significant inroads in certain markets. The WPC market was 320,000 metric tons in 2001 in the developed countries and the volume is expected to more than double in years to come (Verhey et al., 2002).

Recently, WPCs have just been introduced into the Nigerian market under the trade name of Compo-Wood. They are now being used for both structural and non-structural applications. Characterisation of these composites in terms of strength and sorption properties will be beneficial to the Nigerian populace who are now utilising these items for building construction. This work seeks to examine the strength and sorption properties of the Nigerian made wood plastic composites.

Materials and Method

The materials used for this study were purchased from COMPO wood sales depot in Oluyole estate Ibadan. Two different wood plastic products (WPC 100A and WPC 100B) were obtained and cut into five test samples of 150 x 50 x 10mm and 50 x 50 x 10mm for strength and sorption tests respectively.

Flexural Test

The flexural tests were conducted on a Universal Testing Machine at a cross – head speed of 1mm/min. The samples were loaded until failure occurred from which the moduli of rupture (MOR) and elasticity (MOE) were evaluated.

Water Absorption and Thickness Swelling Test

The test samples were weighed and then immersed in distilled water at room temperature for 2 to 48 h. At the end of 2, 24 and 48 h, each test samples were withdrawn from water and allowed to drain before the final weights and thicknesses were taken to the same degree of accuracy. The water absorption and thickness swelling for each test piece was calculated as:

$$water\ absorption = \frac{final\ weight - initial\ weight}{initial\ weight} \times 100$$

$$thicknesss\ welling = \frac{final\ thicness - initial\ thickness}{initial\ thicness} \times 100$$

Results and Discussion

Moduli of Rupture and Elasticity

The MOR and MOE of the WPCs were between 11.6 and 15.7 N/mm^2 and 1254.6 and 1510.2 N/mm^2 relatively (Table 1). These values are low in comparison with those of Migneault *et al*. (2008) and Schrip and Stender (2010) (24 – 34 N/mm^2 and 3045 – 4582 N/mm^2). This indicates that the tested WPCs cannot be used for load bearing applications but as insulating components in ceilings.

Table 1: Moduli of Rupture and Elasticity of Wood Plastic Composites

Samples	MOR	MOE
A	1254.6^B (101.8)	11.6^B (0.87)
B	1510.2^A (120.8)	15.7^A (2.11)

Means with the same letters are not statistically different.
Standard deviation in Parentheses

Table 2: Analyses of Variance of Moduli of Rupture and elasticity of Wood Plastic Composites

Source	Df	Mean Square	
		MOR	MOE
Samples	1	24.81*	98048.17*
Error	4	2.61	12483.12

· Significant at 0.05 level of probability

Water Absorption (WA) and Thickness Swelling (TS)

The WA and TS of the composites after 2 and 48 h immersion in water were 2.1 and 6.1% and 2.1 and 5.4%, respectively (Table 3). The WPCs are generally dimensionally stable suggesting that they can be used for exterior applications. Analysis of variance revealed that the product types did not affect the sorption properties (Table 4).

Table 3: Sorption Properties of Wood Plastic Composites

	WA	TS
A 2 h	0.6^B (0.2)	1.2^B (1.0)
A 24 h	5.3^A (0.3)	2.2^B (1.0)
A 48 h	6.4^A (0.5)	4.9^A (1.6)
B 2 h	2.1^B (2.4)	2.1^B (1.5)
B 24 h	5.7^A (2.6)	2.9^B (1.7)
B 48 h	6.1^A (2.7)	5.4^A (2.0)

Means with the same letters are not statistically different.
Standard deviation in Parentheses

Conclusions

Based on the results obtained from this study, the following conclusions are drawn: the locally produced wood plastic composites have low strength values and are only suitable for non-structural purposes in ceiling, panelling etc. The products are generally dimensionally stable with a low moisture sorption and thickness swelling. Hence they are applicable to both exterior and interior applications.

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