Science World Journal Vol 13(No 1) 2018
www.scienceworldjournal.org
ISSN 1597-6343

Full Length Research Article

TEMPERATURE EFFECT ON WATER ABSORPTION IN AN IMPROVED PERIWINKLE REINFORCED CEMENT STABILISED MUD BRICK

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ABSTRACT
Studies have been carried out on the water absorption of the improved periwinkle reinforced cement stabilized lateritic bricks. These bricks were produced at different cement to laterite to periwinkle ratio of 1:3:1, 2:3:1, 3:3:1, 3:2:1, 3:1:1, and fired at an elevated temperature of 1000^{0}C and 1150^{0}C, respectively. From the results, the mechanical properties of hardness, strength (compression) increased with temperature while the water absorption decreased, drastically. It also shows that porosity leads to increase in water absorption with decrease in cement quantity. The decrease in percentage of water absorption was observed to increase with modulus of rupture and compressive strength of the bricks.

Keywords: Water Absorption, Temperature Effect, Periwinkle, Modulus of Rupture, Mechanical Properties of Hardness

INTRODUCTION
Laterite soil constitute an important soil group occurring in the tropics and mostly used for construction purposes. Laterite is a highly weathered material, rich in secondary oxides of iron, aluminium or both, it is nearly void of bases and primary silicates, it is either hard or capable of hardening on exposure to wetting and drying (Opara, 1999).

Adding a reinforcement into a laterite soil as a building material is one of the simplest process to improve its compressive strength and resistance to water absorption rate (Ogbonda and Nwala, 2014). Joyeshkuma and Umriga (2013).

Mbumbia *et al* (2000) have shown that brick made from lateritic soil can be improved upon to produce strength high enough to meet building standard. Omubo-Pepple *et al* (2010) studied cement stabilized bricks with sea shell addition but the influence of the water content was not investigated in the studies. Alausa *et al* (2013) studied the thermal characteristics of laterite-mud and concrete-block for walls in building construction in Nigeria, without investigating water content.

Consequently, most of these bricks, fired and unfired are mostly used for structural purposes, and are exposed to different meteorological conditions. It is therefore important to determine their water absorption capacity, as it relates strength, hardness and its temperatures. In this study therefore, the water absorption of reinforced cement stabilized lateritic brick is examined.

MATERIALS AND METHODS
The locally sourced materials used in this study, were laterite, Portland cement, well grinded periwinkle shells, weighing balance, and water. The ratio of cement to laterite to periwinkle shells are 1:3:1, 2:3:1, 3:3:1, 3:2:1, 3:1:1. The bricks have the dimensions of 15cm x 15cm x 30cm.

Table 1: The percentage composition of cement and laterite

Compound	Cement	Laterite
S_1O_2	20.1	68.35
Al_2O_3	5.2	6.30
Fe_2O_3	3.9	18.40
Ca O	64.1	0.15
Mg O	2.2	0.25
Na_2O	1.4	0.85
K_2	1.4	0.60
SO_3	1.2	-
T_1O_2	-	0.15
Light on ignition	0.5	4.95

Source: Ogbonda and Nwala (2014)

Table 2: Physical characteristic of laterite

Bulk density (kg/m^3)	1.80
Compressive strength (N/m^3)	4.6
p^H	9.20
Mechanical composition of clay	28%
Silt	26%
Sand	46%
Soluble	0.50%

Experimentation
The reinforced brick is put in a ventilated oven at a temperature of 105^{0}C to 115^{0}C to dry, to attain a substantially constant mass. The brick is cooled at room temperature, and its weight obtained using a scale balance The weighed specimen is taken as W_1, the dried brick is then immersed completely in clean water at a room temperature of 27^{0}c for 28 days, after which the brick was removed and all the pores of water were wiped with damp cloth and weighed the wiped brick from water, (W_2),
Percentage Water absorption (%N) is given by the equation (1) below

$$\%N = \frac{w_2 - w_1}{w_1} x100 \quad (1)$$

RESULTS AND DISCUSSION
Table 1 and 2 show the results of water absorption for the periwinkle reinforced cement stabilized brick fired at 1000^{0}c and 1150^{0}C, respectively.

Table 3: Water absorption of brick at 28 days fired at 1000⁰C

	Bricks	Ratio of body composition	Dry weight (W_1)	Wet weight (W_2)	Water absorption (%)
PRCSLB	1	1:3:1	889,33	912.33	2.59
	2	2:3:1	900.67	920.67	2.22
	3	3:3:1	887.67	904.00	1.84
	4	3:2:1	942.67	957.67	1.59
	5	3:1:1	900.67	910.00	1.04

Table 4: Water absorption of brick at 28 days fired at 1150⁰C

	Bricks	Ratio of body composition	Dry weight (w_1)	Wet weight (w_2)	Water Absorption (%)
PRCSLB	1	1:3:1	902.67	920.33	1.97
	2	2:3:1	910.67	925.33	1.61
	3	3:3:1	931.67	938.00	0.67
	4	3:2:1	929.67	934.67	0.54
	5	3:1:1	968.67	972.67	0.41

The result obtained during the experimental process, shows that the periwinkle reinforced cement stabilized bricks are good building material, for use in the rural and urban areas of Niger delta-region of the country. This is because of its low water absorption rate. The result further shows that brick fired at an increased temperature has an increased water resistance performance because the spores created during the brick production were closed as a result of firing temperature. Ogbonda *et al* (2012) observed that increased firing temperature results in brick weight loss. In general weight loss under firing temperature over 1000⁰c is attributed to the loss of organic matters in laterite.

Figures 1-3 show that water absorption generally decreases with an increase in cement and decrease in quantity of laterite. This is because cement has lower retentive capacity to moisture as compared to laterite. The additions of well graded periwinkle shells reduced the numbers of increased porosity in the brick that leads to increased water absorption. Also the decrease in percentage of water absorption was observed to increase with modulus of rupture and compressive strength of the material (bricks). Figure 3 shows that the brick fired at an increased temperature of 1150⁰c is lighter to that fired at 1000⁰C, the density increased linearly as the firing temperature was raised from (1000⁰C to 1150⁰C). This finding is related to the quantity of water absorbed at this point and the decreasing porosity. When bricks absorbed more water, they exhibits a larger pore size resulting in a lighter density.

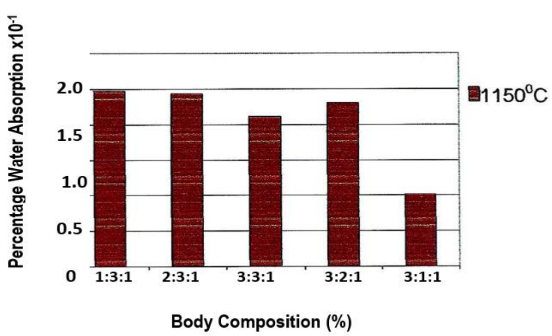

Figure 1: Water Absorption at 1150⁰c

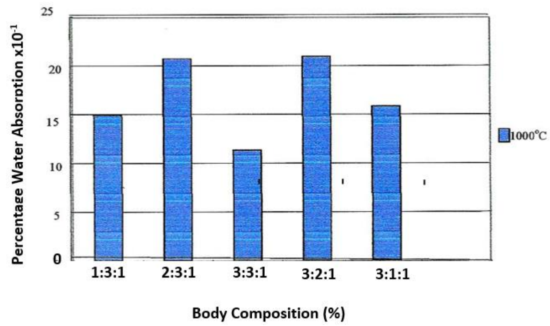

Figure 2: Water Absorption at 1000⁰C

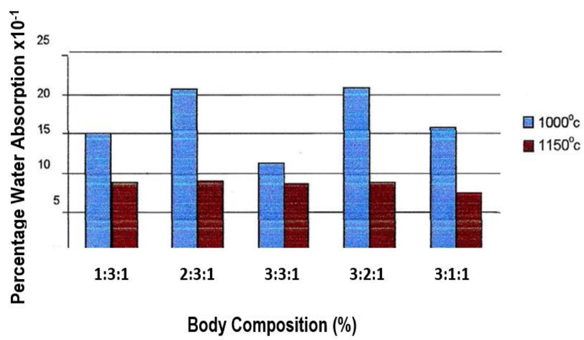

Figure 3: Chart showing Water Absorption at 1000⁰C and 1150⁰C

Conclusion

Based on the investigation of the water absorption of the periwinkle reinforced cement stabilized lateritic brick (PRCSLB), the bricks show an accepted rate of absorption compared to the maximum allowed percentage of (40%) according to Nigeria building and road research institute (NIBRRI) for 28 days strength, the percentage decrease of water absorption is found to be 1.04% and 0.41%, respectively. In fact absorption is much less than these values, when these bricks are immersed in rain water. The brick is environmentally friendly and should be put to optimum use in building houses and construction works in coastal areas.

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