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Compressive Strength of Stabilized Interlocking Bricks with Rice Husk and Sawdust Ashes as Pozzolans.

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***Abstract**: The challenge of high cost of housing in the country has awakened the sense of economical resource management in the populace. People are being inspired to go back and take a closer look at the resources which they have earlier condemned, so as to find ways through which they could put such materials into use again. This is mainly because there is an increased competition for available materials as multiple uses of such resources are being discovered, and the cost of acquiring these suitable materials increases alongside. Major steps have thus been taken to make research into putting abandoned materials into full use again* [10]. *Moreover, various studies are being carried out to discover better ways of achieving this goal, ways that will cost less and would be more economical when compared to using materials that naturally meet requirement standards* [2]. *In this research, rice husk and sawdust ashes were used as pozzolans to supplement cement in various percentages to stabilize the lateritic soil for the bricks. It was thereafter discovered that RHA shows sign of being more pozzolanic than SDA. Bricks made with both pozzolans however, met the Nigerian Building and Road Research Institute's minimum standard of 1.65 N/mm^2.*

***Keywords:** Strength, Interlocking, Bricks, Pozzolans*

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I. Introduction

Housing is one of the necessities of life after food. The need and importance of housing to cater for the ever increasing urban population in Nigeria is causing serious challenges to urban dwellers and the government. It has been observed that over 16 million houses are what Nigeria needs to curb the present shortage[4] This huge gap is not farfetched from the high cost of conventional building materials in Nigeria [1]. It is heartwarming that in order to cut down on the cost of housing, a wide gamut of research works tailored towards the development of technological solutions including increased varieties in the improvement and use of local soils such as laterite, clay, plastic wastes etc. have been initiated [3]. To this end, [7] reported that research works on laterite with a view to investigating its usefulness wholly as a construction material or partly as a substitute for fine aggregate components of concrete have been on the increase in recent times.

In a bid to consolidate on the gains already made in this direction, it will not be out of place to investigate the properties of cement-stabilized lateritic bricks with partial or whole replacement of the cement contents with pozzolanic materials as an alternative to sand-cement (sandcrete) block walls in buildings with a view of reducing the overall cost of buildings.In this study, locally available pozzolanic materials – rice husk ash (RHA) and saw dust ash (SDA), will be used as replacement to Portland limestone cement at various percentages of the lateritic brick. All specimens cast will be cured by covering with tarpaulin and tests will be carried out at 28, 56, 108, and 365 days. The compressive strength values obtained for each experimental run will be analyzed using the Response Surface Methodology (RSM). This analysis will determine the best/optimal mix proportioning of lateritic bricks in which cement has been wholly or partly replaced with RHA and SDA.

II. Experimental Procedures

A. Materials

i.) Cement: The cement used was Portland limestone cement CEM II/A-L of grade 42.5N
ii.) Lateritic soil: This was sourced locally within Ado-Ekiti
iii.) Pozzolan: rice husk ash and saw dust ash were used as cement replacement.
iv.) Water: potable water was used

B. Method

In this research work, laterite was air dried, pulverized and mixed thoroughly with Portland limestone cement (CEM II) within the range 0 – 5 %. Water was added and mixing continues until a homogenous mix was obtained with a water content of the range 20 – 25 % of soil. The damp mix was poured into the mould of a locally fabricated mechanical press machine, after lubrication with oil. A wooden pallet was placed at the bottom of the mould to allow easy removal of the bricks after being pressed. The damp mix was poured into the mould with the aid of a shovel and tamping carried out with a 20 mm diameter rod. The machine was then covered and vibrated. The fresh brick and the wooden pallet were carried carefully to a shade and covered with polythene bags to avoid loss of moisture.

Compressive strength test was carried out by crushing the brick using an electrically operated seidner compressive strength machine . The brick was placed between the plate of the compressive machine and an incremental force was applied until the brick crumbled. The applied load at this stage was noted and this was repeated with various curing periods. The comprehensive strength (N/mm^2) was then determined using equation 1.0

$$\text{Compressive strength} = \frac{force}{surfacearea} \qquad 1.0$$

III. Results And Discussion

The test results are presented in tables 1.1 and 1.2 for rice husk and sawdust ashes respectively and inline with the experimental design earlier carried out using the response surface methodology (RSM).

Table: 1.1 Compressive test result for bricks with rice husk ash

IDENTIFIER	POZZOLANIC MATERIAL %	CEMENT CONTENT %	WATER CONTENT %	COMPRESSIVE STRENGTH N/mm2		
				28 DAYS	56 DAYS	108 DAYS
VA1	3.75	1.25	21.25	1.38	1.48	7.53
VA2	0	5	20	4.94	2.3	9.37
VA3	1.25	3.75	22.5	1.46	1.12	6.78
VA4	1.25	3.75	21.25	1.18	1.77	7.06
VA5	5	0	20	1.25	3.82	6.38
VA6	0	5	25	2.92	5.21	9.81
VA7	3.75	1.25	22.5	1.08	4.22	7.16
VA8	1.25	3.75	23.75	2.63	4.24	8.33
VA9	5	0	25	2.17	3.39	5.31
VA10	3.75	1.25	23.75	2.78	5.39	6.7
VA11	0	5	22.5	5.5	7.6	9.01
VA12	2.5	2.5	22.5	4.89	6.57	5.58
VA13	5	0	22.5	1.94	4.8	4.49
VA14	2.5	2.5	23.75	3.97	5.33	5.26
VA15	2.5	2.5	25	4.29	4.77	6.01
VA16	2.5	2.5	21.25	4.18	3.7	6.28
VA17	2.5	2.5	20	5.04	4.66	7.21

Table: 1.2 Compressive test result for bricks with sawdust ash

IDENTIFIER	POZZOLANIC MATERIAL %	CEMENT CONTENT %	WATER CONTENT %	COMPRESSIVE STRENGTH N/mm2		
				28 DAYS	56 DAYS	108 DAYS
VA1	3.75	1.25	21.25	1.77	3.04	3.21
VA2	0	5	20	1.76	2.84	7.61

VA3	1.25	3.75	22.5	2.67	3.84	4,28
VA4	1.25	3.75	21.25	2.01	4.07	5.31
VA5	5	0	20	0.73	4.01	5.58
VA6	0	5	25	2.37	1.17	7.45
VA7	3.75	1.25	22.5	1.88	2.27	2.73
VA8	1.25	3.75	23.75	1.68	3.46	5.13
VA9	5	0	25	1.57	3.68	4.65
VA10	3.75	1.25	23.75	1.8	1.96	3.2
VA11	0	5	22.5	1.96	7.21	10.52
VA12	2.5	2.5	22.5	4.96	6.03	4.73
VA13	5	0	22.5	3.4	1.67	5.24
VA14	2.5	2.5	23.75	4.29	3.78	4.06
VA15	2.5	2.5	25	4.56	3.76	4.16
VA16	2.5	2.5	21.25	4.69	4.35	4.13
VA17	2.5	2.5	20	5.86	4.15	4.51

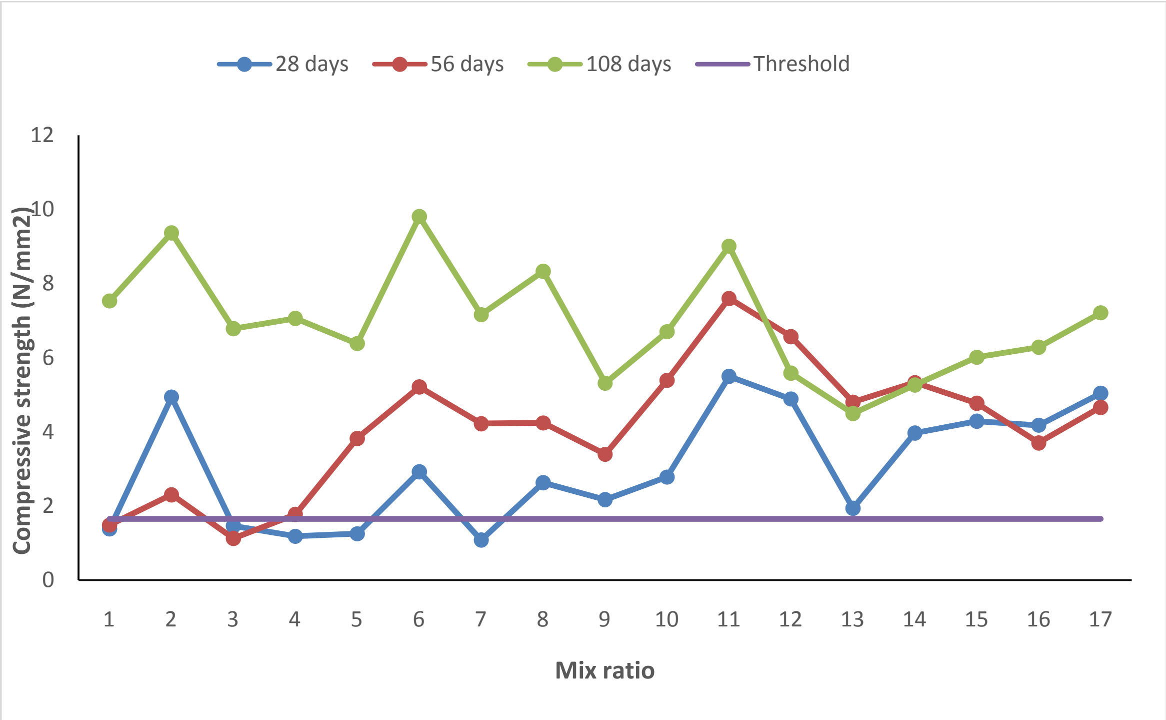

Fig. 1.1 Deviation of Compressive Strength from NBRRI Standard with RHA used as pozzolan

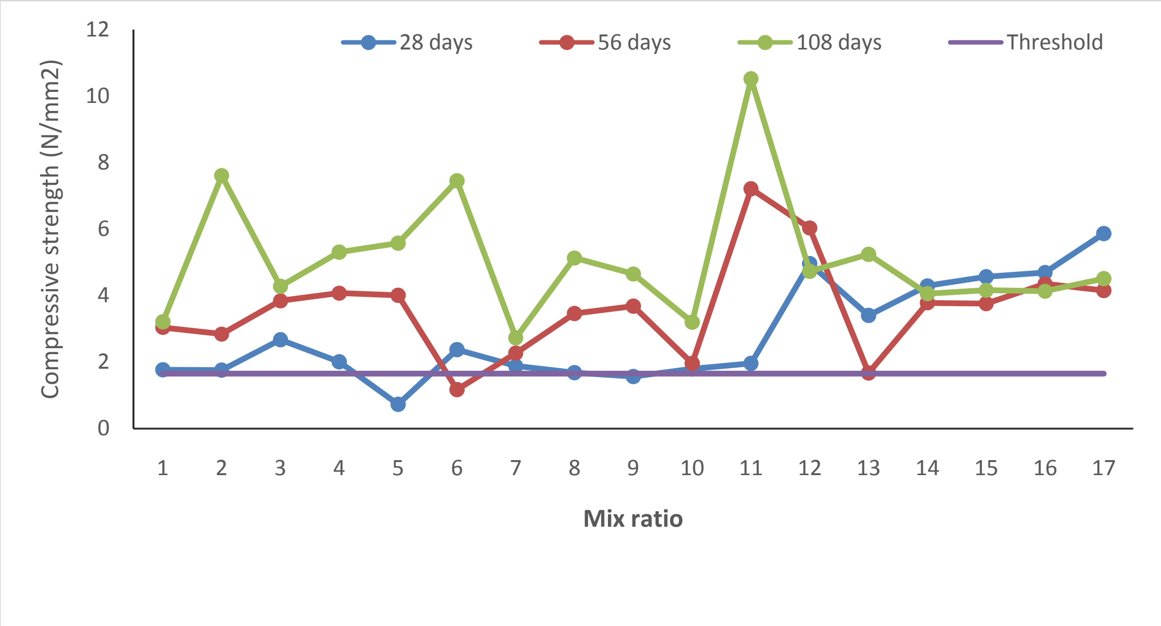

Fig. 1.2 Deviation of Compressive Strength from NBRRI Standard with SDA used as pozzolan

It can be deduced from fig.1.1 that with RHA as pozzolan, mix ratios VA2, VA6 and VA11 gave good compressive strength as the ages increase from 28 to 108 days. With SDA as pozzolan, fig.1.2 shows that VA 11 shows an increase in strength as the age increases. At 108 days, VA2 shows an increase in strength though it initially declined at 28 to 56 days.

IV. Conclusion

Generally, this research shows that bricks with both RHA and SDA as pozzolans has their compressive strengths increasing as their ages increase. Though it can be deduced that RHA shows sign of being more pozzolanic than SDA, bricks made with both pozzolans still met the Nigerian Building and Road Research Institute's minimum standard of 1.65 N/mm^2.

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