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EFFECT OF MOUND SOIL ON CONCRETE PRODUCED WITH RIVER SAND

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ABSTRACT

In this research work, the effect of mound soil on concrete produced with river sand was investigated. A mixed proportion of 1.1.8:3.7 with water cement ratio of 0.47 were used. The percentage replacement of river sand with mound soil is 0%, 5%, 10%, 20%, 30% and 40%. Concrete cubes of 150mm x 150mm x150mm of river sand/mound soil were cast and cured at 3, 7, 28, 60 and 90 days respectively. At the end of each hydration period, the three cubes for each hydration period were crushed and their average compressive strength recorded. A total of ninety (90) concrete cubes were cast. The result of the compressive strength test for 5- 40% replacement of river sand with mound soil ranges from 24.00 - 42.58N/mm^2 a against 23.29-36.08N/mm^2 for the control test (0% replacement).The workability of concrete produced with

5- 40% replacement of river sand with mound soil ranges from 47- 62mm as against 70mm for the control test.

KEYWORDS*:* Compressive Strength; Workability; Mound Soi;, River Sand.

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1.0 INTRODUCTION

Concrete is a mixture of cement, water and aggregate in a given proportion. Aggregate represents some 60- 80% of the concrete volume. They are inert grains bound by means of a binder which is cement. Although inert, they introduce an important contribution to these major characteristics which make concrete the most favoured building material [1]. Aggregates help to reduce shrinkage and heat dissipation during hardening and also contribute to the increase in the mechanical strength of concrete [2]. Concrete generally represent 12-14% of concrete weight. During the hardening process, it generates shrinkage and heat dissipation phenomenon which leads to material cracking [3]. Water occupies 6-8% of the composition of fresh concrete. It provides for cement hydration and for the workability of fresh concrete mixture [4]. [5] reported that the standard workability tests are not suitable for aggregate concrete since they are sensitive to unit weight. [6] made similar observations when working with some materials. The incorporation of mound soil in concrete manufacture may provide a satisfactory solution to the problems posed by concrete production [7]. Finally, the incorporation of mound soil should not impair concrete durability. Tradition assessment methods must therefore be adopted to evaluate this material [8].

This study contributes to the development of a methodology for assessing concrete manufactured from the mound soil. The methodology is based on the study of concrete containing this material. The durability and the environmental impact of concrete are closely connected to its transport properties which control the kinetics of the penetration of water and aggressive agent into concrete [9]. The movement of chemical species within the material and the leaching of certain chemicals are also closely linked to concrete diffusivity[10]. Finally, the strength characteristics of concrete containing increasing levels of mound soil were studied to identify its effect on concrete produced with it.

2.0 METHODOLOGY

Concrete mixtures with six levels of mound soil ranging from 5- 40% and concrete mixtures with no mound soil were investigated to determine its effect on strength of concrete. The mixtures were labeled M0, M5, M10, M20, M30 and M40 with the different mound soil replacement percentages of river sand represented by the final digits in the label. The mixtures were proportioned for a target cube strength of 43N/mm^2 and had a cementitious material content of 340kg/m^3, a fine aggregate content of 627kg/m^3, a coarse aggregate content of 1273kg/m^3 and a water cement ratio of 0.47.

The mound soil used in this research work was obtained locally from where termites leave. The fine aggregate used was clean river sand, free from deleterious substances with a specific gravity of 2.62 and bulk density of 1533kg/m^3. The coarse aggregate was obtained from a local supplier with a maximum size of 20mm, specific gravity of 2.65 and bulk density of 1467kg/m^3. Both aggregates conforms to [11] and [12] respectively for coarse and fine aggregates. The cement used was Ordinary Portland cement (Dangote) which conforms to [13].

Test to determine density, workability and compressive strength were carried out in this study. For the compressive strength test, mound soil was used to replace 0-40% of rivers sand by weight. For the compressive strength test 150mm cube specimen was used. A total of 90 specimens were cast and cured in water at room temperature in the laboratory for 3,7,28,60 and 90 days.

At the end of each hydration period, three specimens for each were tested for compressive strength and the average recorded.

For the workability test, a standard slump cone measuring 300mm x 200mm x 100mm was used. The compaction was also in three layers as carried out in compressive strength that is, one third of its height, two-third of its height and filled up completely. Each layer was compacted using a tamping rod.

3.0 RESULTS AND DISCUSSIONS

Table 1 shows the chemical analysis of mound soil. The table shows that mound soil contain sand, clay, silt and other elements like Fe, Zn, Ca, Mg, k and some ions such as H^+, AL^{3+}, $S0_4^{2-}$. The result of the analysis also shows that mound soil have a PH of 6.50 which indicates its acidic nature. Table 2-7 shows the result of the compressive strength of concrete with 0-40% replacement of river sand with mound soil. The result shows that strength development increases with increase in hydration period. The result of the compressive strength for 5-40% replacement of river sand with mound soil ranges from 24.00 -42.58N/mm^2 as against 23.29-36.08N/mm^2 for the control test.

The result shows that there is an increase in the strength of concrete produced as the percentage replacement level of river sand with mound soil increases. The increase in strength may be due to the presence of Fe, Zn, Ca, Mg, k in mound soil which are not present river sand. Also, the increase in strength may be due to the fact that mound soil is acidic which neutralizes $Ca(OH)_2$ produced when water is added in cement. This is because the presence of $Ca(OH)_2$ in concrete matrix reduces the strength of concrete.

Table 8 shows the result of workability of concrete produced when mound soil are used at a certain when mound soil was used in a certain replacement level of river sand. The result of workability for 5-40% replacement of river sand with mound soil ranges from 47-62mm as against 70mm for the control test. The result shows that the higher the workability of concrete produced, the lower the strength of concrete and vice-versa.

Table 1: Chemical analysis of mound soil

Property	Mound soil
PH	6.50
Clay (%)	14.50
Silt(%)	6.40
Sand(%)	79.10
Fe(mg/kg)	48.16
Zn(mg/kg)	2.82
$S0_4^{2-}$	1.18
Ca(meq/100g)	4.83
Mg(meq/100g)	0.36
K(meq/100g)	0.41
CEC(Meq/100g)	6.28
(H^+ + AL^{3+}) (Meq/100g)	0.3

CEC = Cation Exchange Capacity

meq = milli equipment

Table 2: Result of compressive strength obtained with 0% replacement of river sand with mound soil.

Cube size (mm)	Age of cube (days)	Test load (KN)	Compressive strength (N/mm^2)	Average compressive strength (N/mm^2)
150x150x150	3	560	24.89	
150x150x150	3	500	22.22	23.29
150x150x150	3	512	22.76	
150x150x150	7	530	23.56	
150x150x150	7	590	26.22	25.48
150x150x150	7	600	26.67	
150x150x150	28	705	31.33	
150x150x150	28	633	28.13	29.11
150x150x150	28	627	27.87	
150x150x150	60	700	31.11	
150x150x150	60	796	35.38	35.32
150x150x150	60	888	39.47	
150x150x150	90	660	29.33	
150x150x150	90	821	36.48	36.08
150x150x150	90	955	42.44	

Table 3: Result of compressive strength obtained with 5% replacement of river sand with mound soil.

Cube size (mm)	Age of cube (days)	Test load (KN)	Compressive strength (N/mm^2)	Average compressive strength (N/mm^2)
150x150x150	3	573	25.47	
150x150x150	3	528	23.47	24.00
150x150x150	3	519	23.07	
150x150x150	7	531	23.60	
150x150x150	7	623	27.69	25.96
150x150x150	7	598	26.58	
150x150x150	28	701	31.16	
150x150x150	28	626	27.82	29.51
150x150x150	28	665	29.56	
150x150x150	60	705	31.33	
150x150x150	60	800	35.56	35.73
150x150x150	60	907	40.31	
150x150x150	90	677	30.09	
150x150x150	90	833	37.02	36.86
150x150x150	90	978	43.47	

Table 4: Result of compressive strength obtained with 10% replacement of river sand with mound soil.

Cube size (mm)	Age of cube (days)	Test load (KN)	Compressive strength (N/mm^2)	Average compressive strength (N/mm^2)
150x150x150	3	570	25.33	
150x150x150	3	550	24.44	24.47
150x150x150	3	532	23.64	
150x150x150	7	539	23.96	
150x150x150	7	658	29.24	26.43
150x150x150	7	587	26.09	
150x150x150	28	695	30.89	
150x150x150	28	648	28.80	29.84

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150x150x150	28	671	29.82	
150x150x150	60	699	31.07	
150x150x150	60	839	37.29	36.09
150x150x150	60	898	39.91	
150x150x150	90	680	30.22	
150x150x150	90	855	38.00	37.38
150x150x150	90	988	43.91	

Table 5: Result of compressive strength obtained with 20% replacement of river sand with mound soil.

Cube size (mm)	Age of cube (days)	Test load (KN)	Compressive strength (N/mm^2)	Average compressive strength (N/mm^2)
150x150x150	3	540	24.00	
150x150x150	3	593	26.36	24.80
150x150x150	3	541	24.04	
150x150x150	7	540	24.00	
150x150x150	7	622	27.64	26.71
150x150x150	7	641	28.49	
150x150x150	28	684	30.40	
150x150x150	28	660	29.33	30.13
150x150x150	28	690	30.67	
150x150x150	60	769	34.18	
150x150x150	60	787	34.98	36.83
150x150x150	60	930	41.33	
150x150x150	90	880	39.11	
150x150x150	90	796	35.38	38.06
150x150x150	90	893	39.69	

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Table 6: Result of compressive strength obtained with 30% replacement of river sand with mound soil.

Cube size (mm)	Age of cube (days)	Test load (KN)	Compressive strength (N/mm^2)	Average compressive strength (N/mm^2)
150x150x150	3	580	25.78	
150x150x150	3	577	25.64	25.11
150x150x150	3	538	23.91	
150x150x150	7	551	24.49	
150x150x150	7	638	28.36	27.48
150x150x150	7	666	29.60	
150x150x150	28	670	29.78	
150x150x150	28	805	35.78	32.65
150x150x150	28	729	32.40	
150x150x150	60	782	34.76	
150x150x150	60	827	36.76	37.32
150x150x150	60	910	40.44	
150x150x150	90	900	40.00	
150x150x150	90	800	35.56	38.24
150x150x150	90	881	39.16	

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Table 7: Result of compressive strength obtained with 40% replacement of river sand with mound soil.

Cube size (mm)	Age of cube (days)	Test load (KN)	Compressive strength (N/mm^2)	Average compressive strength (N/mm^2)
150x150x150	3	602	26.76	
150x150x150	3	590	26.22	25.70
150x150x150	3	543	24.13	
150x150x150	7	618	27.47	
150x150x150	7	652	28.98	28.96
150x150x150	7	685	30.44	
150x150x150	28	672	29.87	
150x150x150	28	755	33.56	33.48
150x150x150	28	833	37.02	
150x150x150	60	804	35.73	
150x150x150	60	891	39.60	38.13
150x150x150	60	879	39.07	
150x150x150	90	868	38.58	
150x150x150	90	976	43.38	42.58
150x150x150	90	1030	45.75	

Table 8: Result of workability of concrete produced with 0-40% replacement level of river sand with mound soil.

% level of mound soil	Workability (mm)
0	70
5	62
10	59
20	55
30	53
40	47

4.0 CONCLUSION

The conclusion of the study can be summaries as follows:

a) The incorporation of mound soil in the production of concrete will increase the strength of concrete produced.

b) The strength development in the concrete produced increases with increase in hydration period.

c) The workability of concrete produced decreases with increase in the percentage replacement level of river sand with mound soil.

d) Curing is very necessary in concrete in order to ensure the complete hydration of cement.

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