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A Study on the Effect of Sokoto Red Sand on the Properties of Concrete.

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ABSTRACT
This research investigates the effect of sokoto red sand on the properties of concrete. The red sand was obtained from Kalambaina, Rugamande, Jangebe and Gwadabawa sand within sokoto state.A total of 60 cubes were casted and tested at 7, 14, and 28 days of curing. The specific gravity of the aggregate falls within the range of normal weight aggregate with (Kalambaina 2.49, Rugamande 2.51, Jangebe 2.40, and Gwadabawa sand 2.48). Also aggregate obtained from Kalambaina,Rugamande and Gwadabawa sand falls under coarse zone1, while aggregate obtained from Jangebe falls under medium zone2. The result shows that aggregate samples have low percentage of absorption capacity of concrete due to the nature of it porosity having value (Rugamande 3.7%, Jangebe 4.2%, Kalambaina 5% and Gwadabawa sand 2%). The compressive strength of aggregate has the average value due to the failure load (Rugamande 20N/mm^2, Jangebe 25N/mm^2, Kalambaina 27.8N/mm^2, and Gwadabawa sand 29.8N/mm^2). However sand obtained from gwadabawa has the highest strength failure load of 29.8N/mm^2 which is closed to the target strength of 31N/mm^2.

Key words: compressive strength, curing, Aggregate,

I. INTRODUCTION

Concrete is an artificial material used extensively and globally for a long time. Concrete is a composite of coarse aggregate combine with hydraulic paste of cement and water (Bheel et al., 2019). Quality of sand used in the preparation of concrete plays a paramount role in the development of both physical and strength properties of the resultant concrete. Water, cement, fine aggregates, coarse aggregates and any admixtures used should be free from harmful impurities that negatively impact on the properties of hardened concrete. Sand is one of the normal natural fine aggregates used in concrete production (Hannah et al., 2014). Aggregate are inner granular material such as sand, gravel, or crushed stone that, along with water and Portland cement are essential ingredient in concrete (Mark et al., 2010).Despite that aggregate is a filler material, but it has very effect role in produced concrete properties such as durability, workability, tensile strength and compressive strength. The type and properties of fine and coarse aggregate have great effect on the hardened concrete performance, because it consist a large percentage of concrete volume (Alastshan et al., 2015).

A good quality concrete is essentially a homogeneous mixture of cement, coarse and fine aggregate, and water which consolidate into a hard mass due to chemical action between the cement and water. Each of the four constituent has a specific function, the fine aggregate fills up the voids between the paste and the coarse aggregate. The cement in conjunction with water act as a binder. The mobility of the mixture is aided by the cement paste, fines and nowadays, increased by the use of admixtures (Duggal 2012).

Zongjin (2011) stated that the mixture must have just enough water to ensure that each aggregate particle is completely surrounded by the cement paste, that the spaces between the aggregate are filled, and that the concrete is liquid enough to be poured and spread effectively. Another durability factor is the amount of cement in relation to the aggregate (expressed as a three-part ratio—cement to fine aggregate to coarse aggregate). Where especially strong concrete is needed, there will be relatively less aggregate.

Generally, sand for mortar or concrete work should fall within the range of < 4.5mm IS sieve and also should be free from silt, it should be quartz, and free from organic impurities. Fine aggregate is classified as Z_1, Z_2, Z_3,Z_4, therefore proper selection of sand for concrete work is important.According to William (2011), silt is granular material of a size between sand and clay, whose mineral origin is quartz and feldspar. Silt may occur as a soil (often mixed with sand or clay)

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or as sediment mixed in suspension with water (also known as a suspended load) and soil in a body of water such as river. Clay and silt is common present in many gravels and sand deposit. In large quantities, they cause a serious reduction strength workability, and unsoundness due to their retarding action on the hydration of cement.The moisture content of an aggregate is expressed as: If the moisture content is positive, the aggregate has surface moisture and will contribute water to the PCC, while if the moisture content is negative the aggregate is air dry to some degree and will absorb moisture from the PCC, It's important to determine the moisture content of aggregate prior to mixing, because it affects the proportion of mix water needed to achieve the desired water/cementations materials ratio (BaoJian et al., 2016).

It is an undisputable fact that red sand are in abundance in Rugamande,Kalambaina, Jangebe, and Gwadabawa in Sokotostate.This work is aimed to investigate the effect of Sokoto redsand on the properties concrete, the following objectives were drawn.

i- To determine the physical and chemical properties of Sokoto red sand from different deposit site in the study area
ii- To produce concrete using the red sand as fine aggregate within the study areas
iii- To assess the mechanical properties (compressive strength) of the concrete produced.

Table 1 Grading of fine aggregate for concrete- zone I to V (IS. 383-1970)

I.S Sieve No.			7	14	25	52	100
I.S Sieve size	Millimetre				Microns		
	10	4.75	2.36	1.18	600	300	150
Very coarse (zone I)	100	90-100	60-95	30-70	15-34	5-20	0-10
Coarse (Zone II)	100	90-100	75-100	55-90	35-59	8-30	0-10
Fine (Zone III)	100	90-100	85-100	75-100	60-79	12-40	0-10
Very fine (Zone IV)	100	95-100	95-100	90-100	80-100	15-50	0-15
Zone V	___	___	100	100	85-100	65-95	0-60

Source. IS 383-1970

Very fine sand (Zone IV and V of the table 2.1) are not recommended for structural concrete unless field test show that they can be used. Very coarse sand show difficulties in surface finishing of concrete but provide good strength. Fine sand provides more cohesion than coarse sand and hence, less sand will be needed if fine sand is used. While making concrete, coarse aggregate from rocks (of irregular size) will need more sand than rounded coarse aggregate such as river gravel (Varghese, 2012).

II. MATERIAL AND METHODS

In this research work, the materials used in the production of concrete samples are obtained from Sokoto State. Red sand were used as fine aggregate, the coarse aggregate used was 20mm, ordinary Portland cement produced by BUA and water fit for drinking was utilization for the concrete production. Nominal mix design of concrete grade was used and the quantities were determined using the absolute volume method. Cubes were cast using square sized mould of 15x15x15cm. A total of 60 cubes were casted and then cure. fifteen (15) cubes were produced for each sample .Concrete sample was tested at 7, 14 and 28days. At each hydration period five cubes were used also water absorption test were carried out at 28days.

III. RESULT AND DISCUSSION

Sieve Analysis of Fine Aggregate

The result obtained in the sieve analysis of the fine aggregate from different source is illustrated in the table below

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Table 2 RugaMande sand sieve analysis result Sample A. sieve Analysis result

Sieve size(mm)	Cumulative % passing	Requirement Coarse zone1	medium zone 2	fine zone 3
5mm	97	90-100	90-100	95-100
2.35	87	75-100	85-100	95-100
1.18	66	55-90	75-100	90-100
0.600	38	35-59	60-79	80-79
0.300	20	8-30	12-40	15-50
0.150	6	0-10	0-10	0-15
Pan	5			

Source: Research work (2021)

From the table above it can be observed that Rugamande sand has coarse sand which fall under coarse zone1 therefore the sand is suitable in making concrete Based on Varghese (2012)

Table 3 Jangebe sand sieve analysis result Sample B. Sieve Analysis result

Sieve size(mm)	Cumulative % passing	Coarse zone1	Requirement medium zone 2	fine zone 3
5mm	97	90-100	90-100	95-100
2.35	89	75-100	85-100	95-100
1.18	59	55-90	75-100	90-100
0.600	30	35-59	60-79	80-100
0.300	10	8-30	12-40	15-50
0.150	4	0-10	0-10	0-15
Pan	2			

Source: Research work (2021)

The result obtained from the tables shows that Jangebe sand is a Medium zone1 therefore the sand has a fine coarse aggregate which is good for making concrete

Table 4 Kalambaina sand C sieve analysis result

Sieve size(mm)	Cumulative % passing	Coarse zone1	Requirement medium zone 2	fine zone 3
5mm	96	90-100	90-100	95-100
2.35	88	75-100	85-100	95-100
1.18	55	55-90	75-100	90-100
0.600	21	35-59	60-79	80-100
0.300	7	8-30	12-40	15-50
0.150	5	0-10	0-10	0-15
Pan	5			

Source: Research work (2021)

From the table above shows that Kalambaina sand has a fine coarse aggregate which is used for making mortar Also when used in concrete can improve workability Based on Varghese (2012)

Table 5Gwadabawa sand sieve analysis result

Sieve size(mm)	Cumulative % passing	Coarse zone1	Requirement medium zone 2	fine zone 3
5mm	95	90-100	90-100	95-100
2.35	87	75-100	85-100	95-100
1.18	70	55-90	75-90	90-100
0.600	39	35-59	60-79	80-100
0.300	14	8-30	12-40	15-50
0.150	6	0-10	0-10	0-15
Pan	3			

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Source: Research work (2017)

From the table above shows that the Gwadabawa sand were fall through coarse zone I which is used for making mortar. Also, when used in making concrete can improve workability Based on Varghese (2012

4.2 Fresh Concrete

Table 6 workability test result

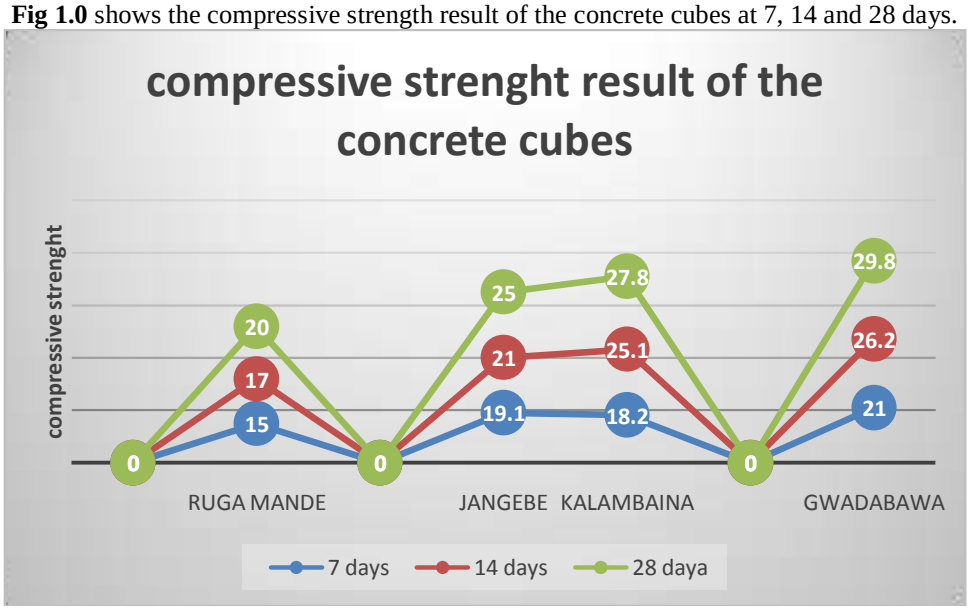
Mix	W/C Ratio	Slump test (mm)	Degree of workability
Rugamande sand	0.58	7	0 – 25
Jangebe sand	0.58	10	0 – 25
Kalambaina sand	0.58	9	0 – 25
Gwadabawa	0.58	10	0 – 25

Source: research work (2021)

The result was compared to the workability test for 0-25% both mixed with the same water cement ratio. The result above indicates that all the mixed fall within the range of very low workability based on Garba (2006). Therefore, all the sand considered to be used in making concrete floors, massive non-reinforced concrete structures.

Compressive Strength

Fig 1.0 shows the compressive strength result of the concrete cubes at 7, 14 and 28 days.



Source: Research work (2021)

From the fig.1.0 above it can be observe that concrete made with Gwadabawasand and kalambaina sand achieved the compressive strength of (29.8N/mm^2 and 27.8N/mm^2) which is close to the target strength of 31N/mm^2. While concrete made with Jangebe sand achieve the compressive strength of 25N/mm^2 at 28 days of curing. Sample indicate Concrete made using Rugamande sand are not strong enough as it produce concrete with low compressive strength of 21N/mm^2. This is to show that the strength of the concrete increase as well as curing period increased and among all the samples indicate that the gwadabawa sand has the highest compressive strength of (29.8N/mm^2).

Table 10water Absorption capacity of concrete of harden concrete

Samples	Average Capacity %
Rugamandesand	3.7
Jangebe sand	4.2
Kalambaina sand	5

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Gwadabawa sand	2

Source: Research work (2021)

From the table 4.6 gives the result of water absorption capacity of concrete made with the sand obtained from the four different sources. It can be observe that concrete cubes made with Gwadabawa sand have lower water absorption capacity (2%) while concrete cubes made with Jangabe sand has the highest value of water absorption capacity (4.2%) respectively. The water absorption result indicate that all the sand obtained from four different sources are suitable for concrete work based on B.S-812 (1990) recommended

Table 4.8: showing the summary of abrasion resistance of concrete cubes. The concrete cubes were tested for abrasion resistance at 28 days of curing.

Table 11 abrasion resistance of concrete samples

Samples	WB (g)	WA(g)	WL(g)	% WL(g)
Rugamandesand	2595.7	2589.7	6	0.23
Jangebe sand	2548.3	2546.3	2	0.12
Kalambaina sand	2620.7	2618.7	2	0.07
Gwadabawa sand	2612.7	2609.7	3	0.11

Source: Research work (2021)

From the table above indicate that the all four-different sample of sand have their own percentage of wear and tear surface of each concrete sample, it can be observed that concrete made with Rugamande sand has higher abrasion resistance value.

IV. SUMMARY OF MAJOR FINDINGS

1. Based on the result obtained shows that gwadabawa sand has the highest compressive strength of29.8N/mm^2 which is closed to the target strength of 31N/mm^2
2. RugaMande, Jangebe, Kalambaina, gwadabawa sand fine aggregate was fall under coarse zone 1 hence is good for making concrete.
3. Concrete made with kalambaina, Jangebe,gwadabawa sand achieved the compressive strength close to the target strength of 31N/mm^2(Gwadabawa sand 29.8N/mm^2 Kalambaina sand 27.8N/mm^2, , Jangebe sand 25N/mm^2).
4. Average density of fine aggregate samples (Rugamande, Jangebe, kalambaina, and Gwadabawasand) was range between 1732.3kg/m^3,1866.6kg/m^3,1817.3kg/m^3, and 1797.5kg/m^3 respectively.
5. The specific gravity of the aggregate samples was fall within the range value Rugamande2.40kg, kalambaina2.49kg,Jangebe 2.51kg,Gwadabawa sand 2.48kg.
6. Based on the result obtained shows that the water absorption capacity test of the concrete cubes shown in table 11 the samples have different water absorption capacities ofRugamande 3.7%, Jangebe 4.2%, kaambaina 5%, andGwadabawa sand 2%, this is to show that the samples of aggregate are suitable in making concrete, because the samples cannot cause swelling and lead to crack.

V. CONCLUSION

Based on the result obtained from Rugamande, Jangebe, kalambaina, andGwadabawa sand were good for making concrete and block works, it also improves workability in the concrete. Since the result show that the concrete strength is not significantly affected when red sand is used in concrete production.

VI. RECOMMENDATIONS

The study therefore recommends the following base on the conclusions:

i. Where concrete compressive strength is of important Gwadabawa sand, Rugamande, and kalambaina sand is recommended.
ii. In an event where concrete workability is needed gwadabawa sand can be mixed with kalambaina to achieve the desired workability.

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