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Qualitative Estimation of Organic impurities on a Selected Cement Sand Aggregate.

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Abstract: *The unethical approach especially with Nigerian construction companies with the manufacturing of concrete bricks and structures with any available sand regardless of its underlying negative impacts. Sand collected from the river bank for construction in Zaria was examined for determination of its level of organic impurities in relation to its standard particle size as fine and coarse aggregates for concrete production. The retained mass of the particles with the respective sieve sizes were interacted ($y= - 25.21x^2 + 83.27x + 163.1$; R2=0.503 & $y= -0.202x^2 + 15.69x + 22.54$; R2=0.821) alongside the retained cumulative mass against the standard sieve sizes as a linear function of $y= - 214.3x +874.5$) for fine aggregate with $R^2=0.817$ and polynomial function of $y= 0.167x^2 – 26.20x + 1025$ for coarse aggregates with $R^2=0.998$. The grading characteristics of the sand samples were also estimated using standard procedures. The results showed that the sand sample particle size distribution indicated that the whole sand sample is technically coarse particles with fineness modulus of 3.245 and 3.501 with the fine and coarse initial classification. Conclusively, protocol (s) with the particle size analysis of cement aggregates and their level of organic impurities should be established for specific construction application.*

Keywords: Cement aggregates, river sand, particle size, grading and organic impurities**.**

1.0 INTRODUCTION

Cement aggregate includes sand, pulverized stone, gravel, granite, slag, and geosynthetic materials. They account for roughly 80 % of the entire Crete volume with the characteristics that directly control the performance of new and cured construction with some impacts on concrete cost-efficiency [1]. Sand aggregate is the cheapest after the watery portion of the Portland cement concrete. By comparison, cement is the most costly part as it usually contributes to 42 % of the total material cost [1]. When aggregate of limited porosity are adopted, the quantity of mixture necessary for sealing these spaces will as well be reduced with optimal strength and applications. Therefore, ideal slurry blending will yield quality concrete output through a reasonable percentage of material. The less the paste at a steady water-cement mixture, the better the shelf life within the prescribed limits. Studies revealed the events of structure collapses in Nigeria are attributable to the nature of poor and quality construction materials [1]. The usual approach, particularly amongst local construction workers generally, is to choose any accessible sand aggregate with undefined characteristics for cement concrete .Large majority of them have no foresight of conducting quality control on the sand samples prior to use. Therefore, the fine sand aggregate to be use in concrete production may not be graded and technically suitable with the composition of some unnecessary natural impurities that diminish the toughness of concrete structures. Sand aggregate is the main component in cement concreting. Sand at the level of 35 percent by concrete and 85 percent by cement mortar are traditionally applied with the construction projects [2]. As construction activities are on the increased owing to population growth and industrialization, the demand for high quality fine aggregate has escalated and thus the scarce resources of good quality sand from the rivers inside economical resources are really being drained rapidly. Technically, the use of bad sand concentrations with blackish-greenish colour and foul odors is strongly discouraged. The organic contaminants with carbons components in the sand are in the state of plants or trees and animal remains [2]. Therefore, such version of sand is undesirable to be used in construction activities as the consistency of sand is strongly dependent on the physicochemical, petrologic and mineralogical properties [3]. The class of sand aggregate adopted must reflect a strong impact on the quality of the concrete material. Hence, the preference of sand availability is technically associated with the clay content in sand equivalent, aggregate particle shape and particle size distribution of the aggregate. Research studies reveal that aggregates should not further be regarded as neutral fraction of concrete as their vital role in conventional concrete has been acknowledged

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with respect to their physicochemical and thermal properties [4]. Similar claims with the naturally occurring organic contaminants disturb the hydration cycle that eventually hampers the strength formation [1]. Moreover, aggregate compressive strength offers fracture toughness to the concrete structure as its generates higher dimensional accuracy [1].Despite required aggregates and sizeable molds with tidy cement matrix, It would automatically result in destruction on further drying with concrete [1]. Such mixtures generate higher density concrete aggregate with less porous output. Inordinate coarse aggregate, conversely generate product with substandard wear resistance even as the extreme sand mixture generate product that demand rough amount of water for impactful finishing [1]. As well, microstructure of fine aggregate has a major role on the application, isolation, and strength of the concrete mix. Several researchers conclude that evenly distributed aggregates produce greater robustness compared to the gap-graded blends. However, higher defects are achieved as certain qualities of the set concrete are clearly influenced with grading. From the research conducted in Kenya where sands from eight points were evaluated to explore the parameters of sands against their impact on concrete bond strength. The outputs illustrated that, the strength of the bond existing between the bars and the concrete reduced with the advancement in the quantity of clay, silt and the organic impurities [1]. Given the fact that aggregates are readily available, acquiring them is a serious challenge with regard to their environmental cost. Majority of the aggregates are excavated from the surface of the earth with the remaining part from water bodies. Environmental interruption including noise pollution results throughout the course of drilling or shattering rocks. Unfortunately, the sites of such rock quarrying can be pre exposed to earthquake and unrestrained erosion. The inflow of this tendency declares the danger of such method to the environment. These aggregates are indiscriminately obtained as there is paucity of information on the nature of the aggregates frequently employed for structural applications in Nigeria as both the local firms that have no capacity to analyze and client that can afford the financial implications for further analysis. As a result, this contribute to the indiscriminate use of concrete sand. The resultant implication is that inferior constructions with detrimental effects on humans are developed. We therefore examined some selected samples of sands with the objectives of determining the effects of their particle sizes (coarse and fine) with respect to their level of organic impurities.

2.0 Materials and methods

The sand sample was obtained from river bank in Zaria Kaduna State, Nigeria.

Sodium Hydroxide Solution: 30 g sodium hydroxide in 970 ml of water to provide a 3% solution.

Reference Colour Solution: 2 g of tannic acid shall be dissolved in 10 ml of ethyl alcohol and the

Mechanical sieve shaker, digital weight scale and dry oven

2.1 Grading

This is the spreading of an aggregate as calculated by a sieve analysis [6]. The standards for fine [7] and coarse aggregate sieves sizes [8] are seven sieves sizes ranges between150 µm and 9.5 mm and thirteen coarse aggregate sieves sizes are from 1.18 mm to 100 mm respectively.

2.2 Test Procedure for Organic Impurities

The sand shall be taken as delivered, and not dried. A 350 ml clear medicine glass bottle is filled with up to 75 ml 3% NaOH solution. The categorized graded sand samples were applied gradually, until the sand layer is 125 ml in thickness. In the voids of sand particles some of the NaOH solution gets filled up. Again, the NaOH solution is added to set level to the 200 ml mark. To make intimate contact of sand particles with the NaOH solution, the bottle is capped and shaken vigorously, and the mixture is allowed to settle for 24 h. The color above the sand of the suppressant solution is compared to the color of the normal reference solution after 24 hours. When the suppressant solution above the sand is darker than normal reference solution color, then it is assumed that the sand sample contains organic compounds. Since the exam No numerical value is produced, accuracy and precision determination is not practical. This approach is of significance when making a preliminary sand acceptability determination. When a sample subjected to this test produces darker colour, then it is advisable to perform the test for the effect of organic impurities on compressive strength of mortar prepared using this sand [5]. Using above procedure all sand samples were tested for presence of organic impurities. It was observed that only four samples contain organic impurities

2.3 Determination of Fineness Modulus of Coarse and fine river sand aggregates

The fineness modulus of coarse aggregates reflects an index number for the average particle size in the coarse aggregate. It is estimated by using regular sieves to perform the sieve analysis. Coarse aggregate means the aggregate that is held on a sieve of 4.75 mm when it is sieved through 4.75 mm. We need sieve sizes of 80 mm, 40 mm, 20 mm, 10 mm, and 4.75 mm, to find fineness modules of coarse aggregate. 2.36 mm, 1.18 mm, 0.6 mm, 0.3 mm and 0.15mm. [9].

Fine aggregate in the other hand is the sum passing through the sieve of 4.75 mm, 2.36 mm, 1.18 mm, 0.6 mm, 0.3 mm and 0.15 mm to find the fineness modulus of fine aggregate. Finer aggregate modulus is smaller than coarse aggregate fineness modulus [10].

The fine aggregate sample in a pan was dried in an oven at a temperature of 110^{o}C as the sample was weighed afterwards.

3.0 RESULTS AND DISCUSSION

Table 1. Standard Grading and organic impurity status of the selected sand aggregates.

Sieve Size (mm)		Mass Retained (g)		Cumulative Mass Retained(g)		Cumulative % Retained		Organic Impurities		Fineness Modulus	
Fine	Coarse	Fine	Coarse	Fine	Coarse	Fine	Coarse	Fine	Coarse	Fine	Coarse
4.75	80.00	0	0	0	0	0	0	present	Present	3.245	3.501
2.36	40.00	170	235	170	235	17.0	23.5	present	Present		
1.18	20.00	220	330	390	565	39.0	56.5	Absent	Present		
0.60	10.00	345	232	735	797	73.5	79.7	Absent	Present		
0.30	4.75	215	110	950	907	95.0	90.7	Absent	Absent		
0.15	2.36	50	90	1000	997	100.0	99.7	Absent	Absent		
-	1.18	-	3	-	1000	-	350.1	-	Absent		
-	0.60	-	0	-	1000	-	-	-	Absent		
-	0.30	-	0	-	1000	-	-	-	Absent		
-	0.15	-	0	-	1000	-	-	-	Absent		
Total						324.5	350.1				

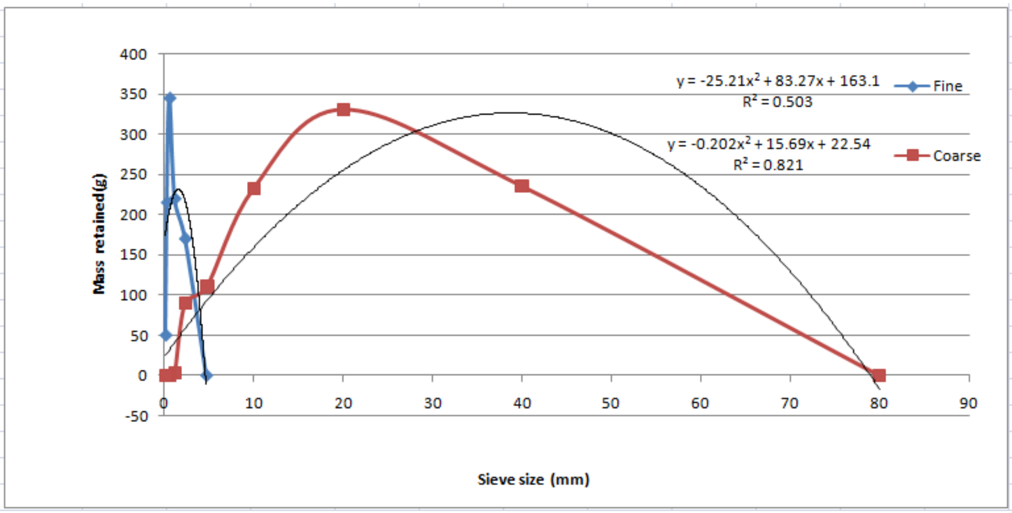

Figure 1. Correlation of the retained particle mass of the fine and coarse sand aggregates with the standard sieve sizes.

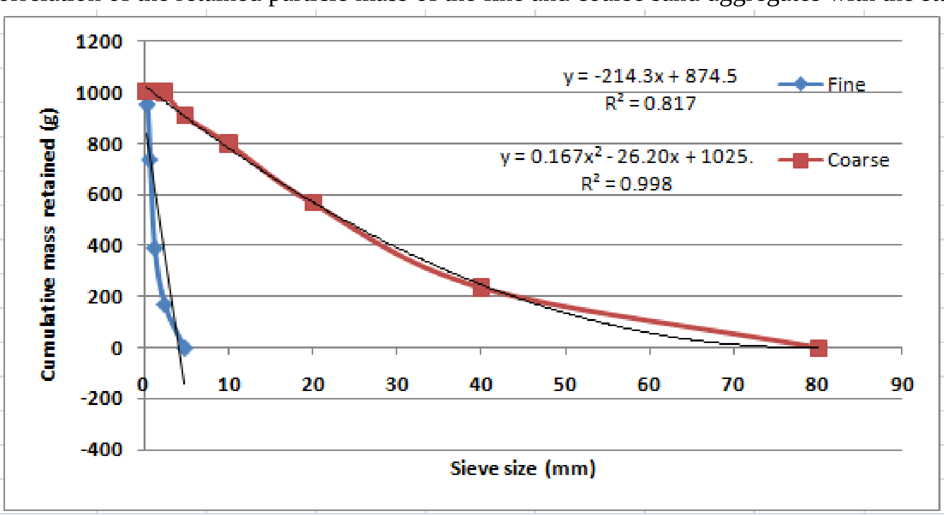

Figure 2. Correlation of the cumulated particle masses of the fine and coarse sand aggregates with the standard sieve sizes.

Table 2. Modulus range of coarse aggregate [9]

Maximum size of coarse aggregate	Fineness modulus range
20	6.0 - 6.9
40	6.9 – 7.5
75	7.5 – 8.0
150	8.0 – 8.5

Table 3. Modulus range of the type of sand aggregate [9]

Type of sand	Fineness modulus range
Fine sand	2.2 – 2.6
Medium sand	2.6 – 2.9
Coarse sand	2.9 – 3.2

The standard grading analysis of the fine and coarse sand aggregate within the range of 0.15mm to 4.75mm and 0.15mm to 80mm respectively were reported with the evidence of the plot of the retained and that of the cumulated masses of the two aggregates against the sieve sizes (Figure 1 and 2).The interaction between the two aggregates (figure 1) defined their relationships to be polynomial by function($y=-25.21x^2 + 83.27x + 163.1$ and $y= -0.202x^2 + 15.69x + 22.54$) with the level of correlation at 0.503 and 0.821 for fine and coarse samples respectively. The cumulative retained masses of both samples declared a linear ($y=-214.3x +874.5$) (fine) and polynomial ($y= 0.167x^2 – 26.20x + 1025$) functions (coarse) at the correlation strength of 0.817 and 0.998 respectively. The standard guides (table 2 and 3) with respect to the fineness modulus of the fine aggregates of 3.456 and 3.501 with coarse aggregate respectively declares the entire sand sample to be coarse despite the initial technical categorizations. Organic impurity tests with the two samples established a trend of direct relationship with the particle sizes of the aggregates as the test was only qualitative in nature, the presence of the organic matters in these soil samples are perceived to be significant enough to impede the quality of the cement sand aggregate structure.

4.0 CONCLUSIONS

The grading analysis of the sand particles has shown to be a direct function of the physicochemical, petrologic and mineralogical properties. Also, there has been a general observations that river sand is characterized with significant organic impurities that are determined qualitatively on the basis of classical colour comparison. When the suppressant solution above the sand is darker than the colour of standard reference solution, then the sand sample is said to contain high organic compounds. It is desirable that grading and organic impurity test should be considered relevant on sands samples according to ASTM C-87-83 (Vol. 0.04-02) prior to construction applications. These outcomes should guide the local contractors, civil and structural engineers that the sources or origin of the raw sandy aggregate strongly influenced the stabilities of the concrete products. Similarly these will further complement the existing empirical information on the impact of sand quality on concrete properties as the adopted method entails a simpler approach that validate the nature of sand to be used for construction.

CONFLICT OF INTEREST: No

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