International Journal of Academic Engineering Research (IJAER)
ISSN: 2643-9085
Vol. 4 Issue 11, November - 2020, Pages: 55-58

Geotechnical Swell Index, Specific Gravity, Moisture, Electrical Conductivity and Particle Distribution of River Sands for Regular Plastering in Construction

Olabimtan Olabode H[1], Abubakar Zaid[2], Muhammad Rabiu.K[3], Aliyu Hassan[4], Abdulkarim Yahaya[4]

[1]National Research Institute for Chemical Technology,
Department of Industrial and Environmental Pollution Zaria, Kaduna State, Nigeria.
[2]Nigerian Building and Road Research Institute, Northwest Zonal Office,
Department of Engineering Materials Research, Kano State, Nigeria.
[3]Nigerian Building and Road Research Institute, Northwest Zonal Office, Department of Building Research, Kano State, Nigeria.
[4]Nigerian Building and Road Research Institute, Northwest Zonal Office, Department of Road Research, Kano State, Nigeria.
[5]National Research Institute for Chemical Technology, Department of Textile Technology Zaria, Kaduna State, Nigeria.
Corresponding email: Olabode4angel@gmail.com

Abstract: *The detrimental effects of the poor choice of sand with the potential of expansion and contraction under certain unfavorable conditions typically leads to cracks or deformations with total structural collapse. In this vein, river sand which has been a commonly used plaster sand was experimentally evaluated through sensitive geotechnical characteristics such as the free swell index (2.30 ± 0.5333) %, specific gravity (2.52), pH (7.80), moisture composition (0.87%), electrical conductivity (0.01 mS/cm) and size distribution curve of $y = 273.25\ln(x) - 437.73$ ($R^2 = 0.8413$). These outcomes technically justify the importance of river sand as ideal plaster sand in structural construction.*

Keywords: *River sand, plaster sand, expansion, geotechnical characteristics and free swell index*

.

1.0 INTRODUCTION

Soil expansion is the increase in the volume upon saturation as the structure of soils that are confined to this nature of deformation is defined by the emergence of crystal structures that absorb moisture [1]. This indicates the major challenge with the technical applications of most soil in most geographical bearings as these expansive soil induce significant destruction to buildings with negative economic consequences [2]. Research investigators overtime have been attempting the appropriate procedures that could be implemented in avoiding and preventing the potential structural catastrophes. In response, the blending of cohesive and expansive soil with antioxidants as an additive was proposed to enhance the strength performance of expansive soil after absorption and, eventually, to lower the soil swelling pressure [3]. Another recommendation was the application of a tightly packed soil to the lime formulation of 4 percent granulated lime in the management of soil swelling and a one-meter layer of cohesive non-swelling soil has been adopted as pad underlay of drainage designed over a black cotton surface deposit [4]. It was as well revealed that the application of a thick non-swelling soil over the expansive soil layer below the base, is effective in controlling the swelling condition of such soil category [4]. Another experimental study concluded with the expansion capacity in relationship with the pressure to be greatly decreased by replacement with non-swelling material and in relationship with the preservation of the directional slides with waterways around the expansive sediments as active soil replacement with non-expansive soil that controls the volume expansion was suggested [5]. Similarly, to model atterberg's limits, moisture content, swelling characteristics, and conditions, studies have explored the design of interaction effects which help to estimate swelling behaviors from the validity of the experimental data. However, these empirical relationships have not been proven to be true to all soil types as this means that only the fraction of soil sample through sieve number 40 (0.425mm) in line with ASTM "D4318" standard is used to calculate atterberg's limits with the likelihood of affecting the may affect the swelling properties [6]. Soils further possess distinctive geotechnical characteristics, such as specific gravity, moisture content, electrical conductivity, and particle size distribution are very significant in technical evaluations as such detailed analysis is required for structural processes and engineering. Soils with physical and biochemical properties are of organic and inorganic components. They are often defined with their physicochemical parameter like the free swelling index that reflects the upsurge of soil when immersed in water with no external factors. Consequently, the risk of structure destructions due to this effect must be established by the examination of soils that are suspected to give unnecessary expansion with moisture. Meanwhile, with varying experimental conditions, inferential research is being employed to model the ability of the material to swell base on the initial moisture composition, dry density, and other environmental conditions where the specific level of swelling manifests [7]. River sand is extracted from river banks or beds as fine substances that are composed of fine grey and white colored spherical grains. It is readily accessible in perfect condition for plastering of concrete surfaces internal and external. With its fine particles, it makes a very consistent, even surface which can similarly be included in a cement/sand/gravel formulation for paving construction of cracks [8]. Secure, economic, and technological designs for projects with expansive soils can be assured by sand features of this nature.

2.0 MATERIALS AND METHOD

International Journal of Academic Engineering Research (IJAER)
ISSN: 2643-9085
Vol. 4 Issue 11, November - 2020, Pages: 55-58

Analytical balance, 425 micron IS sieve, 250ml measuring cylinders, and glass rod.

2.1 Sampling

River sand samples were obtained from a particular construction site within Zaria metropolis.

2.2 Selected Geotechnical parameters

Specific Gravity [9], moisture content [10], free swell index [11], particle size distribution test [12], and the electrical conductivity [13] were conducted accordingly.

3.0 RESULTS AND DISCUSSION

Figure 1. Typical River sand

Figure 2. Swell test in distilled water

Figure 3. Swell test in kerosene

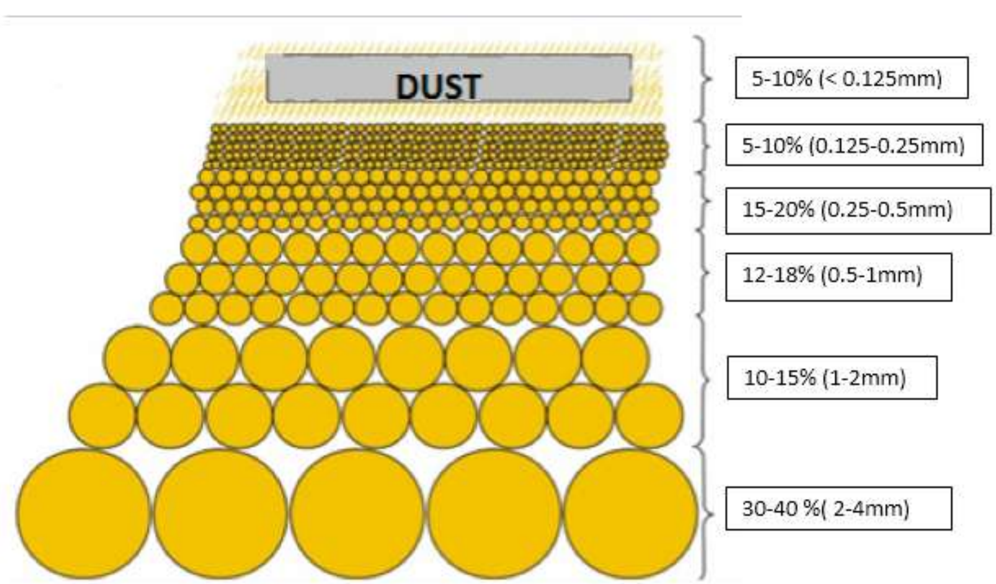

Figure 4. Grain size distribution of plaster sand [12]

International Journal of Academic Engineering Research (IJAER)
ISSN: 2643-9085
Vol. 4 Issue 11, November - 2020, Pages: 55-58

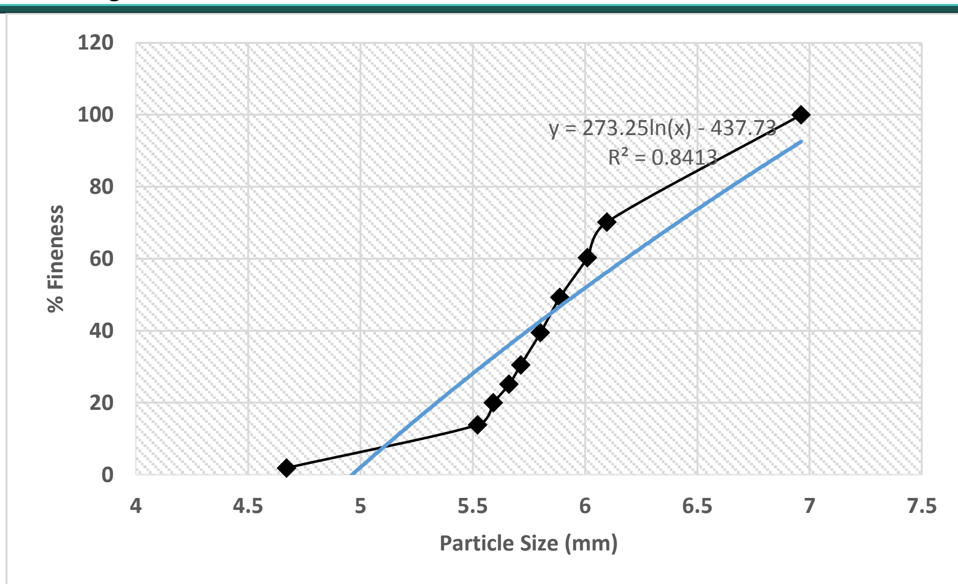

Figure 5. Particle size distribution curve of river sand.

Table 1. Classical Determination of free swell index of river sand

Run	Volume height of soil with distilled water (V_d) (ml)	Volume height of soil with kerosene (V_k) (ml)	Free swell index (%)
1	107	104	2.884615
2	106	104	1.923077
3	107	104	2.884615
4	107	105	1.904762
5	107	105	1.904762

Table 2. Descriptive statistics to the free swell index determination of river sand.

Statistic	Volume height of soil with distilled water(V_d) (ml)	Volume height of soil with kerosene (V_k) (ml)	Free swell index (%)
Mean	106.80	104.40	2.30
Standard deviation	0.4472	0.5477	0.5333
Maximum point	107.00	105.00	2.88
Minimum point	106.00	104.00	1.91
Range	1.00	1.00	0.98
Average value	106.80 ± 0.4472	104.40 ± 0.5477	2.30 ± 0.5333

Table 3. Other selected geotechnical parameters

TEST	Value
Specific gravity	2.52
Moisture content (%)	0.87
pH	7.80
Conductivity/100ml distilled water (mS/Cm)	0.01

The free swelling index of plaster or river sand (Figures 1, 2, and 3) and standard grain size from the literature (figure 4) was disclosed in table 2. The expansion behavior of the sand in distilled water was more dispersed with the evidence of cloudiness compared to that with kerosene. These activities illustrated the interaction of the water molecules with the sand particles at the same molecular level and zero reaction with the kerosene. The five runs of the test statistically provide average values in terms of the sand volume in distilled water (Vd) as (106.80 ± 0.4472) ml, sand volume in kerosene (Vk) as (104.40 ± 0.5477) ml, and free swell index of (2.30 ± 0.5333) %. Technically, the magnitude of the swell index with the plaster sand of this nature declares a significantly low degree of expansion. The Specific gravity, moisture, pH, and electrical conductivity were established as factors of geotechnical parameters that balance the association of sand particles with moisture. The specific or relative density of 1.52 seems to be of an amount that controls the net weight with the construction eventually. The intrinsic moisture content with this river sand after pretreatment is negligible. pH indicates the alkaline nature of the sand under standard and natural conditions. Similarly, the electrical conductivities at a specified condition with 100ml distilled water at 250C is insignificant in inducing ions activities. The particle size distribution curve of river sand (Fig. 5) revealed its category to be graded as under uniform material which affects the strength, load-bearing properties, and chemical reactivity which needs to be managed in subsequent technical applications.

4.0 CONCLUSIONS

Sand is regularly engaged in construction and must be clean and free from both chemical and physical impurities. However, it is very imperative to recognize the type of sand that will be suitable for a specific type of construction. Therefore, a concise experimental study on commonly used river sand in plastering was conducted as the identified parameters validate the technical rationales in the application of this particular form of sand in construction projects especially in this part of the country.

5.0 REFERENCES

1. AbdulmohsinW et al (2009). Swell Behavior of Expansive Soil with Free Lateral Movements. J King Saud Univ., Vol 22, Eng. Sci. (2), pp. 51-64, Riyadh (201011431). https://doi.org/10.1016/S1018-3639(18)30493-8Igwe, O. and Umbugadu, A.A (2020). Characterization of structural failures founded on soils in panyam and some parts of Mangu, Central Nigeria. Geoenviron Disasters 7, 7. https://doi.org/10.1186/s40677-020-0141-9
2. Chijioke Christopher Ikeagwuani and Donald Chimobi Nwonu, (2019).Emerging trends in expansive soil stabilization: A review, Journal of Rock Mechanics and Geotechnical Engineering, Volume 11, Issue 2, Pages 423-440, ISSN 1674-7755,https://doi.org/10.1016/j.jrmge.2018.08.013.
3. Sherif M. ElKholy (2008). Improving the Characteristics of Expansive Soil Using Coarse-grained Soil. https://www.researchgate.net/profile/Mohammed_AbdelHalim/publication/281591382_Electronic_Control_of_SinglPhase_Induction_Motor_Using_AC_Chopper/links/55ef160c08ae199d47bff9eb.pdf.
4. Magdi M.E. Zumrawi (2015). Construction Problems of Light Structures Founded on Expansive Soils in Sudan. International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438
5. Pao-Tsung Huang et al (2009). Final Report Classification of Organic Soils. FHWA/IN/JTRP-2008/2. https://www.researchgate.net/publication/336678983_Predicting_the_Strength_Properties_of_Swelling_Clay.
6. Adil Binal et al (3016). Improvement of the Strength of Ankara Clay with Self-cementing High Alkaline Fly Ash, Procedia Engineering, Volume 161, 2016, Pages 374-379, ISSN 1877-7058,https://doi.org/10.1016/j.proeng.2016.08.577.
7. Pc's sand stone transport and coal. Pcsand.co.za. (2020). https://www.pcsand.co.za/.
8. Krishna Reddy (2020).ASTM D 854-00 Engineering Properties of Soils Based on Laboratory Testing http://users.rowan.edu/~sukumaran/geotechnical/notes/Experiment%204-Specific%20Gravity.pdf
9. ASTM D2216 - 19 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass. Astm.org. https://www.astm.org/Standards/D2216.)
10. Free swell index (2020).https://wecivilengineers.wordpress.com/2018/01/23/free-swell-index/
11. Slideshare (2020).The grain size distribution of plaster sand.https://www.slideshare.net/mazendag/plaster-sand-properties
12. Rayment, GE & Higginson, FR 1992, Australian Laboratory Handbook of Soil and Water Chemical Methods, Melbourne, Inkata Press. (Australian Soil and Land Survey Handbooks, vol 3)