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Original Research Article

Geotechnical, Physicochemical, and Mineralogical Characterization of Locally Available Plaster Soils in Awka Municipality, Anambra State, Nigeria

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Abstract

In Awka and most parts of Anambra State, plastering is commonly carried out using the cheapest and nearest available materials like river-bed sand dredged from the Onitsha reach of the River Niger or clayey borrow-pit soils excavated locally, which are often mixed by eye, leading to frequent cracking, blistering, delamination, poor bonding, and patchy finishes. This study therefore characterized the geotechnical, physico-chemical, and mineralogical properties of borrow-pit soils from Amansea and Ebenebe, river-bed sand from Onitsha, and four laboratory-prepared blends at 80/20 and 60/40 (sand/soil) ratios using particle-size analysis, Atterberg limits, specific gravity, Standard Proctor compaction, X-ray fluorescence (XRF), and X-ray diffraction (XRD). Results showed that all materials are highly siliceous (SiO_2 77–87 wt.%) and quartz-dominated (86–96 wt.%) with very low fines content (< 0.6 %), making them essentially non-plastic despite the clayey appearance of the borrow-pit soils (kaolinite only 3–7 wt.%). Blending Onitsha river-bed sand with borrow-pit soils significantly reduced fines, water demand, and plasticity while increasing maximum dry density and specific gravity. The 60 % Onitsha + 40 % Amansea blend exhibited the optimum combination: highest maximum dry density (1.86 Mg/m³), low optimum moisture content (11 %), very low fines (0.39 %), and the cleanest oxide profile, clearly outperforming the individual raw materials. The widespread plaster defects observed locally are thus attributable to the use of unblended or poorly proportioned materials, while a simple, controlled 60:40 blend offers a strong, shrinkage-resistant, and sustainable plastering aggregate using only locally available resources.

Keywords: Borrow-Pit Soil, Compaction, Mineralogy, Plastering, River-Bed Sand, XRF, XRD.

1.0 INTRODUCTION

The fundamental and multi-functional role that soils play in civil engineering construction cannot be overemphasized. Soils serve as both aggregates and binders for many construction applications and contribute significantly to the stability, durability, and sustainability of built environment. (Danso, 2018; Nihad, 2020). In geotechnical engineering, soil is defined as "an uncemented or weakly cemented accumulation of mineral particles formed by the weathering of rocks, the void space between the particles containing water and/or air ". (ASTM International, 2017a, 2019a). Determining whether a soil is appropriate for any intended construction purpose requires proper assessment of its engineering properties, rather than depending on visual observation or perceived resemblance to other soil types (Roy & Bhalla, 2017).

Plastering, one of the most common finishing techniques in building construction, predominantly relies on soil, where it is mixed with cement and water to produce mortar for both external and internal wall finishes. These finishes protect structures against environmental factors such as moisture, temperature fluctuations, and physical wear (Devda & Salman, 2024).

In Anambra State, the rapid growth in infrastructure and raising scarcity/cost of conventional material, have led builders to start relying on locally sourced soils from sites like borrow pits and riverbeds, either as soil blends or used with cement for plaster mortars. (Abah *et al*., 2020; Nwakaire *et al*., 2025). They adopt these practice to reduce costs. However, the direct use of these materials without adequate characterization often results in shrinkage cracks, poor adhesion, and reduced durability.

The suitability of soils for making plaster mortar largely depends on its physical, chemical, and geotechnical properties. Researchers around the world use detailed tests such as particle-size distribution, Atterberg limits, specific gravity, Proctor compaction, natural moisture content, X-ray diffraction (XRD), and X-ray fluorescence (XRF) in other to understand how a soil is likely to behave in plaster applications (Azalam *et al*., 2024; Fabbri *et al*., 2018; Lagouin *et al*., 2021; Nwakaire *et al*., 2024, 2025). Lagouin *et al*., 2021 found that the type of clay minerals present, and their activity, especially the cation exchange capacity and the fraction of particles smaller than 2 µm, are better indicators of shrinkage and strength in unstabilized earthen plasters than clay content alone.

In southern part of Nigeria, including Anambra State, tropical soils typically exhibit high clay content, variable plasticity, and significant volume-change potential that can lead to cracking and durability issues in plaster applications if not properly evaluated (Bolarinwa & Ola, 2016). Recent studies have characterized Anambra soils and sharp sand–silty soil blends for road sub-base and rendering applications using geotechnical tests (particle-size distribution, Atterberg limits, specific gravity, and compaction) (Nwakaire *et al*., 2024, 2025). The study reported the basic geotechnical properties of the materials and showed that increasing the silty-soil content led to higher shrinkage and lower strength. However, the work did not include mineralogical (XRD) or chemical composition (XRF) analyses of the soils. ((Nwakaire *et al*., 2024, 2025)

This study builds on earlier research by taking a closer and more practical look at the actual materials builders in Awka and surrounding parts of Anambra State are using for plastering today: clayey borrow-pit soils dug from Amansea and Ebenebe, and river-bed sand dredged from the Onitsha reach of the River Niger. The work became necessary after repeated site visits showed that excavated soils are routinely mixed, usually just by eye, with coarse river sand and cement to make plaster mortar or sometimes used alone with cement whenever regular plaster sand is hard to find or too expensive. Using a sets of geotechnical, chemical (XRF), and mineralogical (XRD) tests on the three individual raw materials and four controlled laboratory blends, this research identifies which local material performs best on its own for plastering, measures how much blending improves key properties, and works out a reliable mix ratio that gives a strong, shrinkage-resistant, and sustainable plaster mortar using nothing but what is already available locally.

2.0 MATERIALS AND METHODS

2.1 Materials

Three soil materials and four laboratory-prepared blends were investigated. Three raw materials were collected: clayey borrow-pit soil from active pits in Ebenebe and Amansea (both in Awka North LGA), and river-bed sand dredged from the Onitsha reach of the River Niger (Onitsha South LGA) (Figures 1 and 2). All materials represent those supplied to construction sites in Awka municipal for plaster mortar production. The blending ratios show the trend adopted in various construction sites in Awka, where builders usually add 40–80 % river sand to borrow-pit soil to improve workability and reduce cracking.

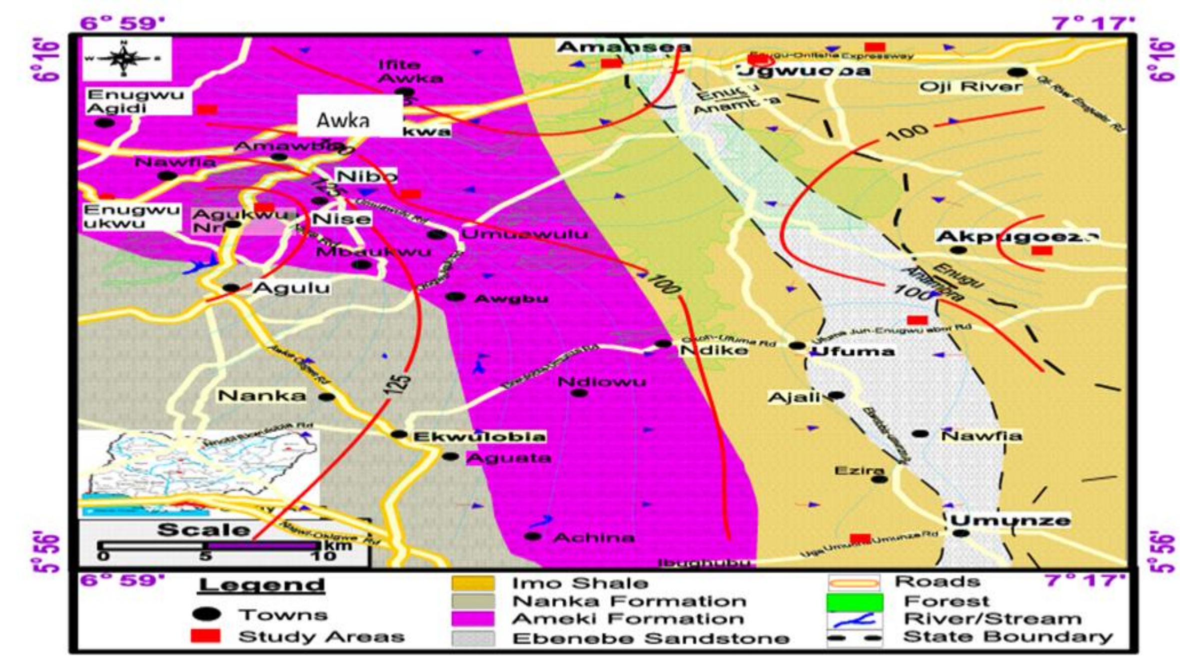

Figure 1: Geological map of Awka North (Ogbuchukwu *et al*., 2019)

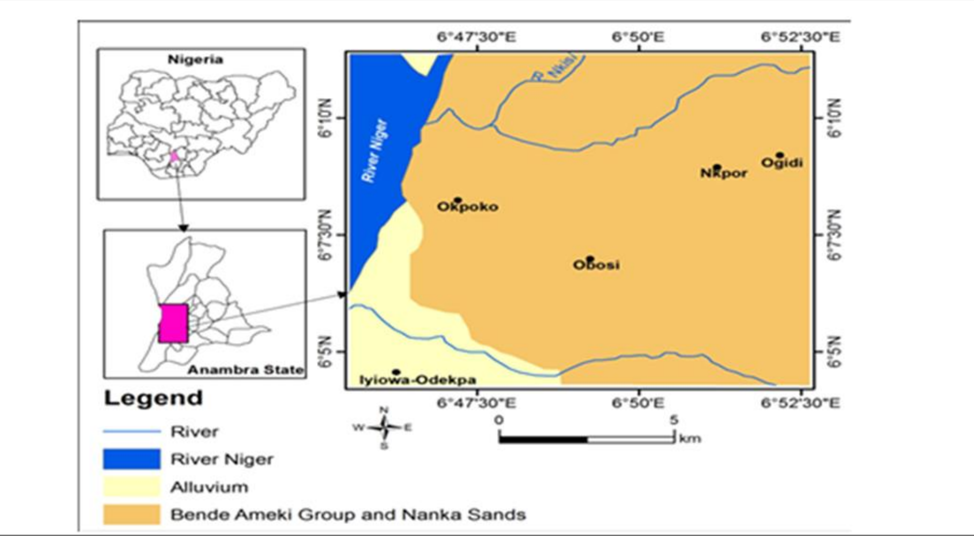

Figure 2: Geological map of Onitsha and River Niger (Asowata & Olatunji, 2019)

2.1.1 Description of Soils and Laboratory Blends

Three raw materials were collected, and four laboratory blends were prepared by thoroughly mixing the dried soils and sand in the proportions commonly observed on site. The sample ID, compositions, and sources are summarized in Table 1.

Table 1: Description and Source of Raw Soils and Laboratory Blends

Sample ID	Composition (dry weight)	Source
EB100	100% Ebenebe soil	Ebenebe, Awka North LGA
ON100	100% river sand	River Niger, Onitsha South LGA
AM100	100% Amansea soil	Amansea, Awka North LGA
ON80AM20	80% Onitsha river sand + 20% Amansea soil	Laboratory blend
ON60AM40	60% Onitsha river sand + 40% Amansea soil	Laboratory blend
ON80EB20	80% Onitsha river sand + 20% Ebenebe soil	Laboratory blend
ON60EB40	60% Onitsha river sand + 40% Ebenebe soil	Laboratory blend

2.2 Sample Collection and Preparation

Disturbed bulk samples (20 kg each) were collected in July 2025 from the parts of the borrow pit currently in use and newly dredged river-sand stockpiles. Samples were sealed in labelled polythene bags and transported to the Soil Mechanics Laboratory, Department of Civil Engineering, Nnamdi Azikiwe University, Awka. The materials were air-dried at room temperature for 10 days, carefully broken up and mixed to obtain representative samples. Blends were prepared by thoroughly mixing the required proportions of oven-dried individual materials.

2.3 Laboratory Tests

All tests were performed in accordance with BS 1377:1990 (Parts 1–8) in the Soil Mechanics Laboratory, Department of Civil Engineering, Nnamdi Azikiwe University, Awka. Mineralogical and chemical analyses were performed at Springboard Research Laboratory, Awka, Nigeria.

1. **Natural Moisture Content**: Natural moisture content is the ratio of the mass of water to the mass of dry solids in a soil sample, expressed as a percentage (ASTM International, 2019b; British Standards Institution, 1990b). Approximately 500 g of each field-moist sample was weighed, oven-dried at 105–110 °C for 24 hours, cooled in a desiccator, and reweighed.
2. **Particle-Size Distribution**: Particle-size distribution classifies soil into gravel, sand, silt and clay fractions (American Society for Testing and Materials, 2000; British Standards Institution, 1990b). Approximately 500 g of oven-dried material was washed through a 75 µm sieve, then dry-sieved using a mechanical sieve shaker with sieves ranging from 200 mm to 0.075 mm. The percentage passing each sieve was calculated.
3. **Atterberg Limits**: Atterberg limits define the critical moisture contents at which soil changes consistency (ASTM International, 2017b; British Standards Institution, 1990c). Approximately 500 g of air-dried material passing the 425 µm sieve was used for each test. Due to the very low fines content (< 0.6 %), consistent groove closure could not be achieved in the Casagrande cup, and all samples were classified as non-plastic.
4. **Specific Gravity**: Specific gravity is the ratio of the density of soil solids to the density of water. (ASTM International, 2019b; British Standards

Institution, 1990b). The test was performed using 50 ml density bottles and 10 g of oven-dried soil passing the 2 mm sieve.

5. **Compaction Test**: Soil compaction is the process of mechanically packing soil particles closer together to reduce voids, thereby increasing the soil's dry density The Standard Proctor test for adopted to determine the maximum dry density and optimum moisture content (American Society for Testing and Materials, 2000; British Standards Institution, 1990a). Approximately 3000 g of air-dried soil passing the 20 mm sieve was mixed with an initial water content of 4 % and compacted in a 998 cm³ mould in three layers, each layer given 27 blows from a 2.5 kg rammer falling 300 mm. The procedure was repeated at increasing water contents until dry density decreased.
6. **Mineralogical Composition**: Mineralogical composition refers to the types and proportions of minerals present in a soil sample. An X-ray diffractogram was used to determine the mineralogical composition of the soil(Moore & Reynolds, 1997). Powdered samples were analyzed using a PANalytical Empyrean diffractometer with Cu-Kα radiation, scanning from 5° to 70° 2θ at Springboard Research Laboratory, Awka, Nigeria.
7. **Chemical Composition**: X-ray Fluorescence (XRF) XRF was used to determine elemental and oxide composition of the soils by measuring characteristic secondary X-rays (Jenkins, 1999). Major and minor oxides were quantified using a Rigaku ZSX Primus IV wavelength-dispersive spectrometer at Springboard Research Laboratory, Awka, Nigeria.

3.0 RESULTS AND DISCUSSION

3.1 Natural Content of Soils and Blends

The pure Onitsha river-bed sand (ON100) showed the lowest natural moisture content at only 2.1 %, as expected from its coarse, free-draining nature. In contrast, the pure borrow-pit soils retained considerably more water: 10.6 % for Amansea soil (AM100) and 21.4 % for Ebenebe soil (EB100), indicating their higher clay content and the wetter environment of the borrow pits.

Table 2: Natural and Optimum Moisture Content of Soils and Laboratory Blends

Sample ID	Natural Moisture Content (NMC, %)
AM100	10.6
EB100	21.4
ON100	2.1

3.2 Atterberg Limits

Atterberg limit tests were attempted on all samples. However, due to the very low fines content (< 0.6 % passing 0.075 mm in all cases), the soils were essentially non-plastic or exhibited very low plasticity. Consistent groove closure could not be reliably achieved in the Casagrande cup for most samples, confirming their classification as poorly graded sands (SP) based solely on particle-size distribution.

3.3Particle-Size Distribution and Grading Characteristics

Particle-size curves (Figure 3) show that all materials and blends are coarse with very low fines (< 0.6 % passing 0.075 mm). Uniformity coefficient (Cu) is 3.4–4.6 and coefficient of curvature (Cc) is 1.05–1.37. According to the USCS system, all are classified as poorly graded soil (Table 3).

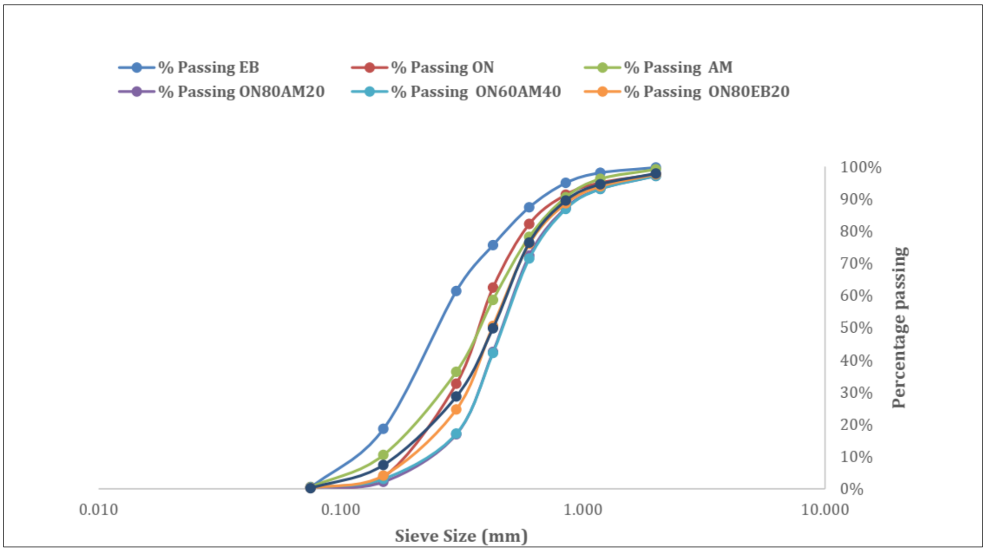

Figure 3: Particle-Size Distribution Curves of Soils Materials and Blends

Table 3: Grading characteristics and USCS classification

Code	D_{10} (mm)	D_{30} (mm)	D_{60} (mm)	Cu	Cc	Grading (USCS)
EB	19	42	88	4.6	1.05	Poorly graded sand
AM	22	48	95	4.3	1.11	Poorly graded sand
ON	28	65	110	3.9	1.37	Poorly graded sand
ON80-AM20	35	72	118	3.4	1.25	Poorly graded sand
ON60-AM40	32	68	112	3.5	1.30	Poorly graded
ON80-EB20	34	70	115	3.4	1.26	Poorly graded sand
ON60-EB40	30	65	108	3.6	1.20	Poorly graded sand

3.4 Compaction Characteristics of the Soil Samples

The results of the compaction tests are shown in Table 3 among the individual soils, Amansea borrow-pit soil recorded the highest maximum dry density (MDD) of 1.78 Mg/m³ at the lowest optimum moisture content (OMC) of 9%. Onitsha river sand produced an MDD of 1.69 Mg/m³ at 16% OMC, while Ebenebe soil gave the lowest MDD of 1.62 Mg/m³ at 11% OMC.

For the blended samples, increasing Onitsha sand in the Amansea mixtures from 60% to 80% reduced the MDD from 1.86 to 1.72 Mg/m³, indicating that the 60% Onitsha and 40% Amansea blend (ON60-AM40) provided the best particle packing. In the Ebenebe blends, increasing Onitsha sand from 60% to 80% slightly increased MDD from 1.59 to 1.69 Mg/m³. However, all Ebenebe mixtures performed worse than the ON60-AM40 blend.

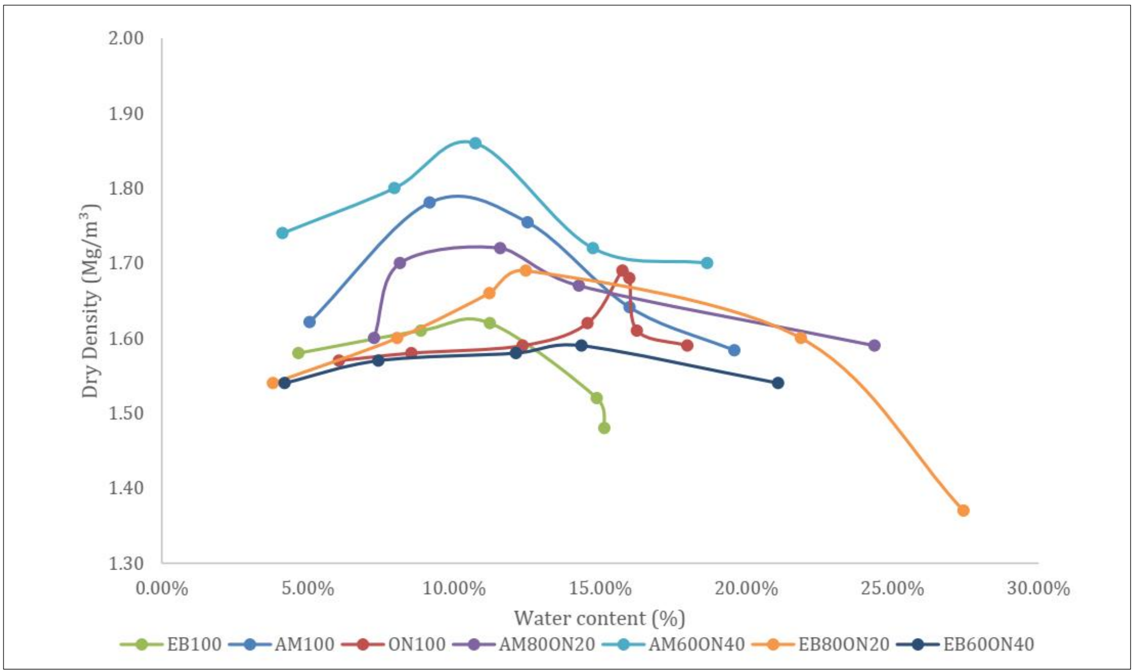

Figure 4: Compaction curves of tested materials and blends (a) soil materials (b) Laboratory blends

Table 4: Maximum Dry Density and Optimum Moisture Content of Soil materials and Blends

Code	Sample Description	Maximum Dry Density (MDD) Mg/m³	Optimum Moisture Content (OMC) %
AM	Ebenebe soil (100%)	1.62	9
EB	Amansea soil (100%)	1.78	11
ON	Onitsha sand (100%)	1.69	16
ON80-AM20	80% Onitsha sand + 20% Amansea soil	1.72	12
ON60-AM40	60% Onitsha sand + 40% Amansea soil	1.86	11
ON80-EB20	80% Onitsha sand + 20% Ebenebe soil	1.69	12
ON60-EB40	60% Onitsha sand + 40% Ebenebe soil	1.59	14

3.4.1 Effect of Grading Characteristics on Compaction Behaviour

The combined effects of fines content and particle grading on compaction behavior are shown in the figures below. Figure 5 shows that the fines content (<0.075 mm) is highest in the pure borrow-pit soils (EB100 = 0.38 %, AM100 = 0.54 %) and lowest in the blends with higher proportions of Onitsha river-bed sand (0.19–0.39 %). Figure 6 presents the uniformity coefficient (Cu) and coefficient of curvature (Cc), with values ranging from 3.4 to 4.6 and 1.05 to 1.37, respectively, indicating that all materials are poorly graded sands. Figure 6 shows that the maximum dry density (MDD) and optimum moisture content (OMC), which vary from 1.59 to 1.86 Mg/m³ and 9 % to 16 %, respectively. Overall, this show that increasing the proportion of Onitsha sand reduces fines, slightly changes grading, and improves compaction characteristics, resulting in denser mixes at lower water content. For plastering, this suggests that blends with more river sand are easier to work with, less prone to shrinkage, and likely to produce smoother, stronger finishes.

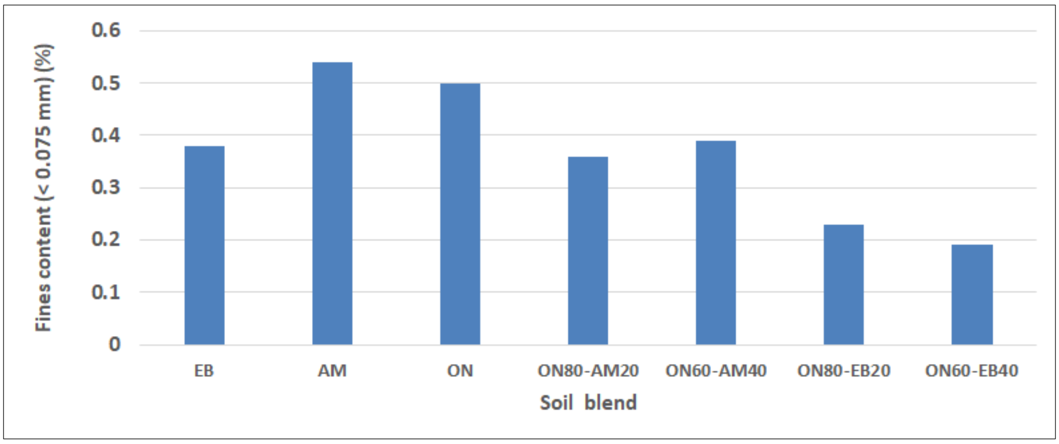

Figure 5: Effect of grading on compaction characteristics (Fines content (< 0.075 mm)

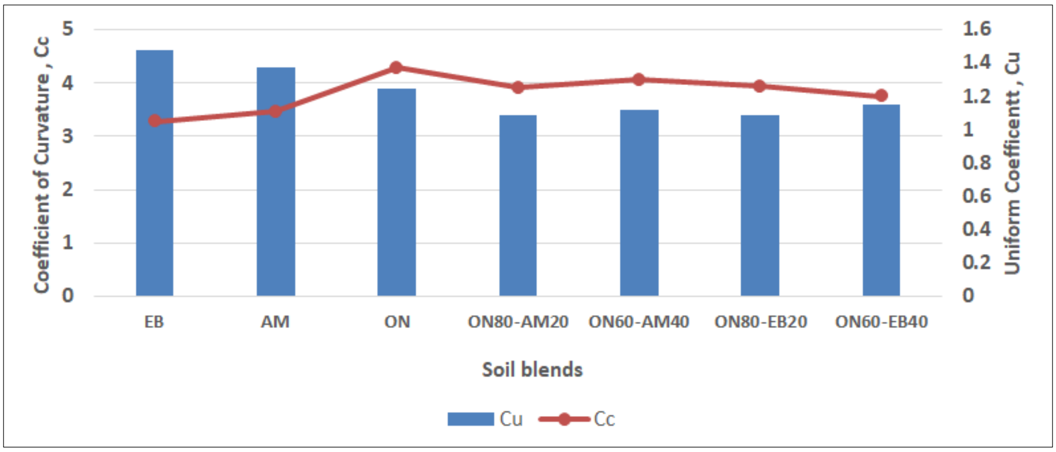

Figure 6: Effect of grading on compaction characteristics (uniformity coefficient (Cu) and coefficient of curvature (Cc)

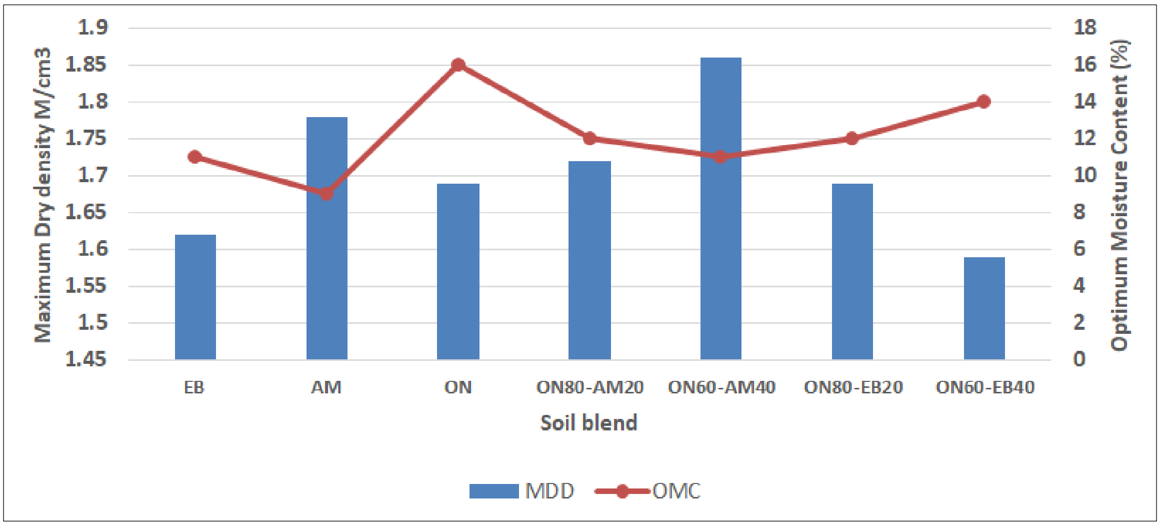

Figure 7: Effect of grading on compaction characteristics (maximum dry density (MDD) and optimum moisture content (OMC)

3.5 Specific Gravity

The specific gravity values of the soils and blends ranged from 2.41 to 2.66 (Figure 8). The pure Ebenebe soil (EB100) had the highest value at 2.66, the Amansea soil (AM100) the lowest at 2.41. Adding Onitsha sand (2.55) to Amansea-based blends raised the specific gravity from 2.41 (AM100) to 2.59 (ON80-AM20) and 2.57 (ON60-AM40), producing a denser, more stable mix. In Ebenebe-based blends, adding Onitsha sand slightly reduced the specific gravity from 2.66 (EB100) to 2.47 (ON80-EB20) and 2.55 (ON60-EB40).

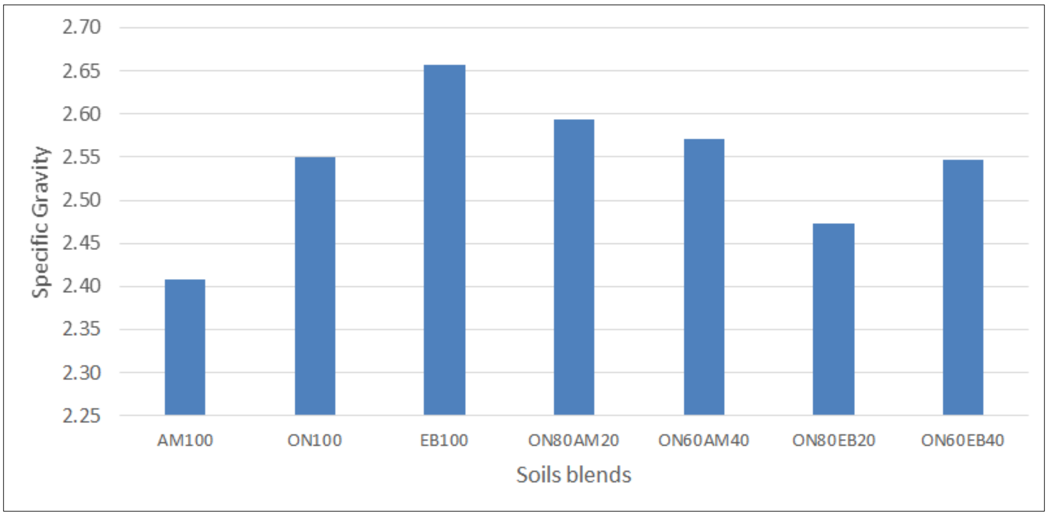

Figure 8: Variation of Specific Gravity with Different Soil and Sand Blends

3.6 Chemical Composition (XRF)

X-ray fluorescence analysis showed that all soils and blends were highly siliceous, with SiO_2 ranging from 77.2 % to 86.7 % (Table 7). The Onitsha river-bed sand (ON100) had the highest silica content and the lowest iron and aluminum oxides, an indication of its quartz-rich content. In contrast, the borrow-pit soils contained higher Fe_2O_3 + Al_2O_3 and titanium oxide, while Onitsha sand was richer in calcium and potassium oxides. Ebenebe soil also had elevated SO_3, suggesting sulfide or gypsum traces. Blending Onitsha sand with borrow-pit soils raised silica and lowered Fe_2O_3 + Al_2O_3 content. Total oxide recovery ranged from 99.1 % to 99.9 %, indicating high sample purity. These changes suggest that adding river sand improves the chemical suitability of the soils for plastering applications.

Table 5: Oxide Composition (%) of Soils Materials and Blends

Oxide	EB100	AM100	ON100	ON80-AM20	ON60-AM40	ON80-EB20	ON60-EB40
SiO_2	84.41	80.20	82.29	83.72	77.17	85.18	86.71
Al_2O_3	4.98	6.58	5.31	7.51	7.55	6.41	5.97
Fe_2O_3	1.38	6.43	2.02	2.35	4.25	1.26	1.20
TiO_2	2.17	2.54	1.10	0.79	2.22	2.09	1.16
CaO	0.64	0.58	1.89	1.60	3.86	0.95	0.97
K_2O	0.15	0.29	4.11	2.20	1.93	2.13	1.20
MgO	0.00	0.00	1.66	0.00	0.00	0.00	0.00
SO_3	4.69	0.69	0.24	0.65	1.05	0.59	1.14
Cl	0.87	1.75	0.77	0.68	1.18	0.75	0.78
Others	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total	99.71	99.07	99.39	99.55	99.21	99.88	99.88

3.7 Mineralogical Composition (XRD)

X-ray diffraction showed that quartz was dominant in all samples (86–96 wt.%), with minor kaolinite, orthoclase, albite, and muscovite/illite (Tables 6)(Figures 9-14). Quartz controls engineering behavior, giving low plasticity, high specific gravity (2.55–2.66), and good compaction (MDD up to 1.86 Mg/m³). Samples with the most quartz (ON80-AM20, ON60-EB40) have the lowest OMC (11–14%) due to efficient packing.

Kaolinite, concentrated in the borrow-pit soils (AM100: 7 %; EB100: 3 %), increased water demand and OMC, but its dilution in blends reduced plasticity and improves compaction. Feldspars in Onitsha sand slightly raise OMC but blending moderates this effect. No swelling clay minerals were detected, consistent with very low fines (<0.6 %) and non-plastic behavior.

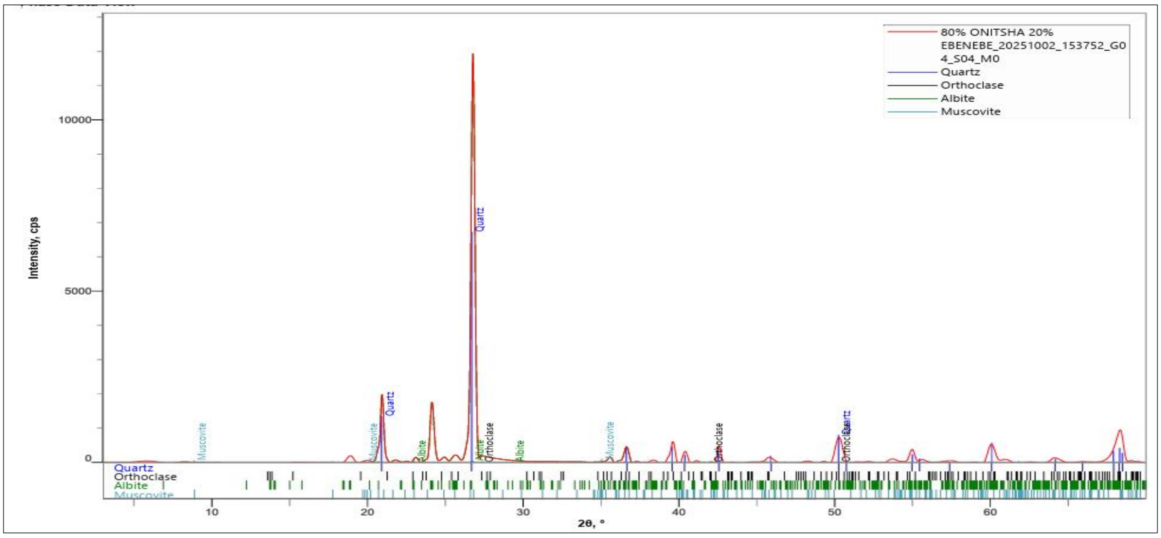

Figure 9: XRD plot for ON80-EB20

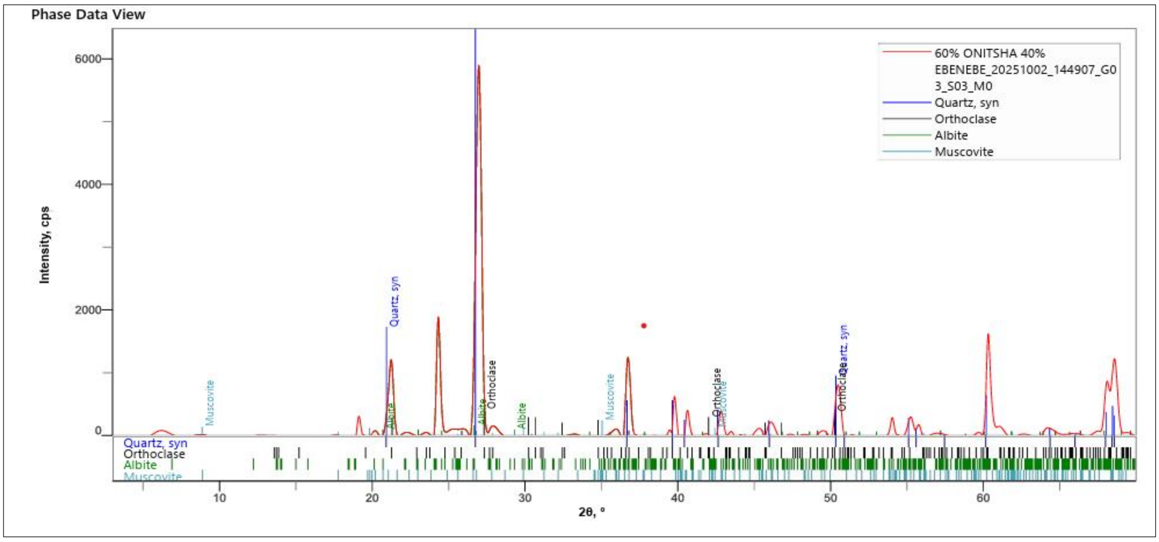

Figure 10: XRD plot for ON60-EB40

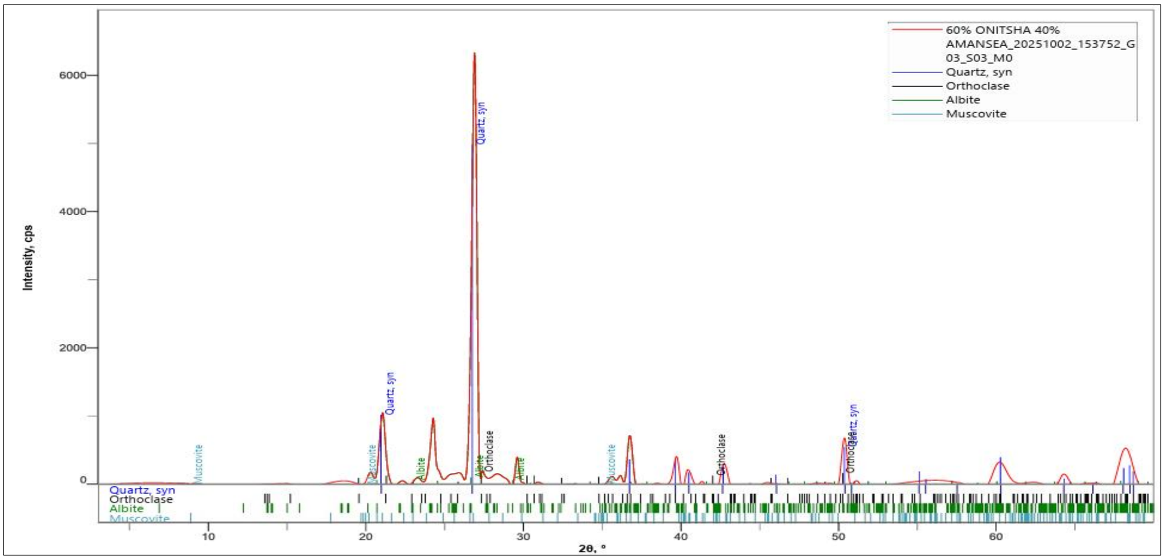

Figure 11: XRD plot for ON60-AM40

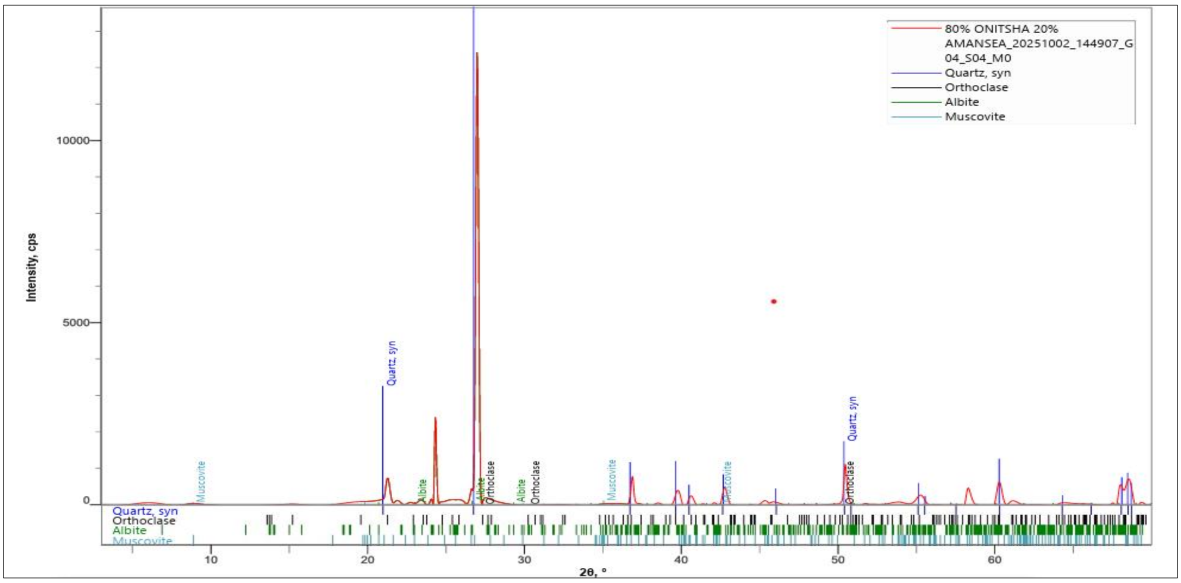

Figure 12: XRD plot for ON80-AM20

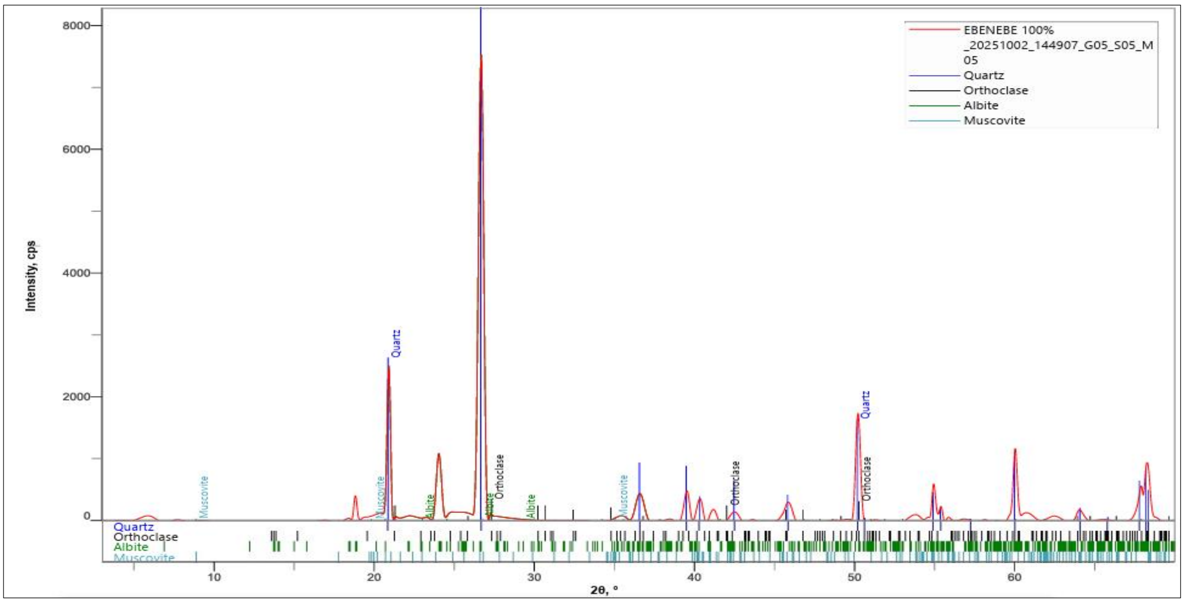

Figure 13: XRD plot for EB100

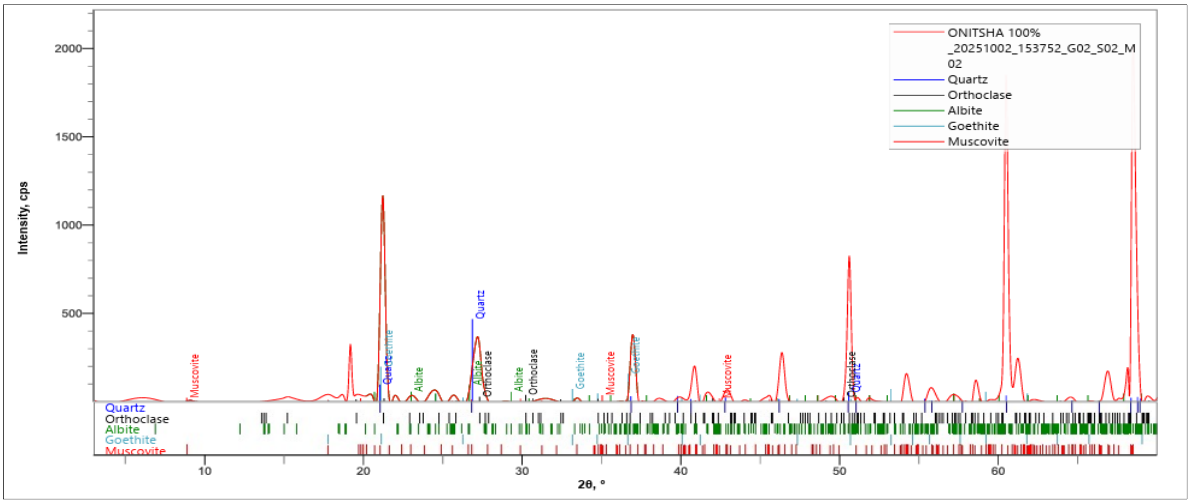

Figure 14: XRD plot for ON100

Table 6: Mineralogical Composition of Samples (XRD Results)

Code	Quartz (SiO_2)	Kaolinite	Orthoclase (K-feldspar)	Albite (Na-feldspar)	Muscovite/Illite	Other
EB100	92	3	2	1	2	Tr
AM100	86	7	3	2	2	Tr
ON100	96	<1	2	1	<1	Tr
ON80-AM20	93	3	2	1	1	Tr
ON60-AM40	90	5	2	2	1	Tr
ON80-EB20	94	2	2	1	1	Tr
ON60-EB40	93	3	2	1	1	Tr

3.8 Relationship between Chemical Composition and Physical Properties

Figure 15 shows an inverse relationship between combined Fe_2O_3 + Al_2O_3 content and specific gravity. Borrow-pit soils, with higher iron and aluminium oxides, have lower specific gravity due to the presence of lighter clay and iron-rich minerals. Amansea soil has the highest oxide content (13.01 wt.%) because it contains more clay and iron-bearing minerals and less quartz, which also explains its lower specific gravity (2.41). In contrast, the quartz-rich Onitsha river-bed sand and high-sand blends have lower oxide contents and higher specific gravity (up to 2.59)

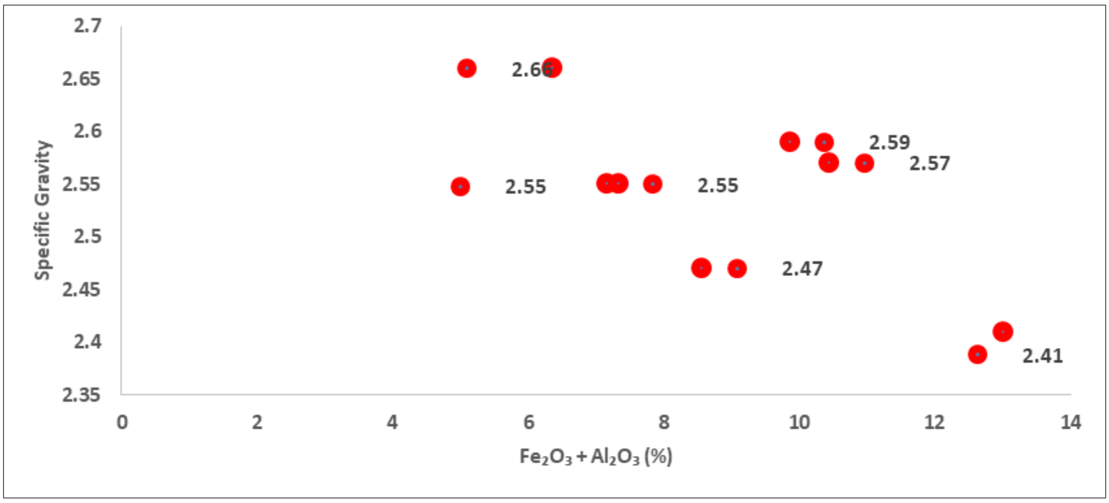

Figure 15: Relationship between combined iron and aluminium oxide content and specific gravity.

3.9 Suitability of the Tested Materials as Plaster Soils

A good plaster soil material or blend should have:

1. High SiO_2 (clean quartz)
2. High specific gravity (> 2.50)
3. High compacted density (MDD > 1.80 mg/m³)
4. Well-graded sand (cu > 6)
5. Very low fines (< 1 %) to avoid shrinkage cracks

The radar chart (Figure 16and 17) compares these materials based on the aforementioned citeria to determine which material has the overall best outcome. Amansea soil (AM100) has the highest density but scores lower due to higher fines and lower specific gravity, while Onitsha sand (ON100) has low fines but requires more water and has lower density.

Increasing the proportion of Onitsha sand in the blends reduces fines, raises SiO_2 content, lowers plasticity, and generally increases specific gravity in Amansea-based mixes, but, it reduces specific gravity in Ebenebe-based blends due to the the soil's naturally higher density. Maximum dry density increases, and optimum moisture content decreases with more sand, indicating better particle packing and reduced water demand. Blends with 60 % Onitsha sand (ON60-AM40 and ON60-EB40) consistently achieve the most balanced combination of high quartz content, low clay fraction, and favorable compaction, making them particularly well-suited for plastering applications.

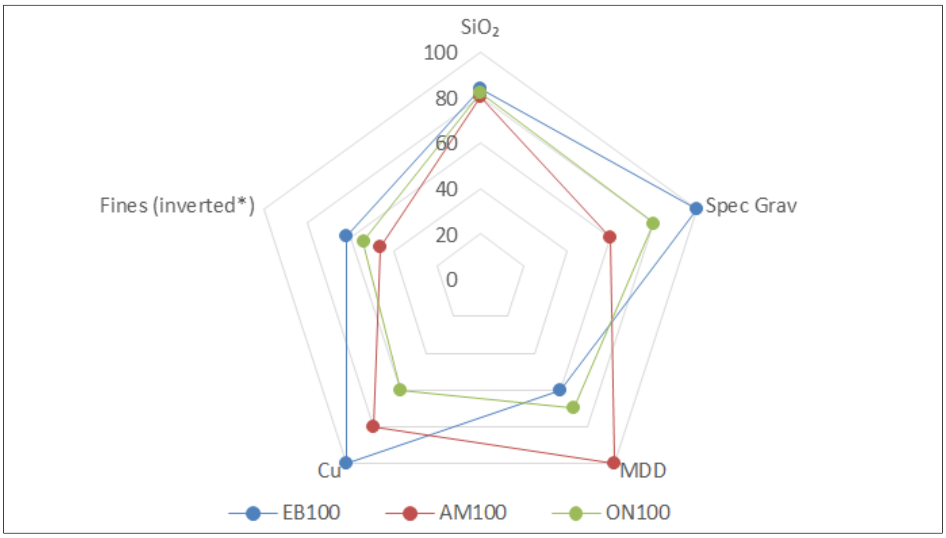

Figure 16: Overall suitability as plastering aggregates (Soil Material (100%))

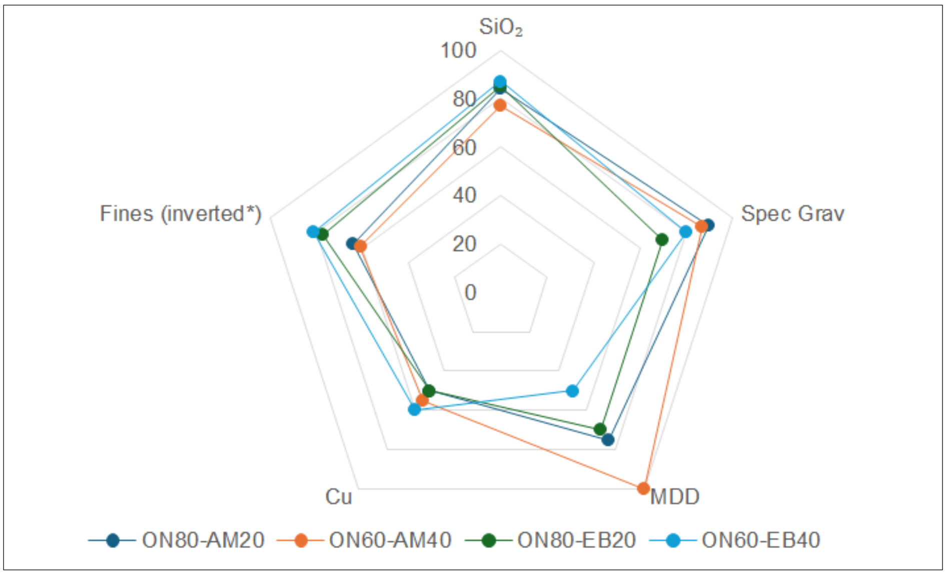

Figure 17: Overall suitability as plastering aggregates (Soil Material (100%)

All parameters are scaled 0–100 (higher SiO_2, specific gravity, MDD, and Cu = better; lower fines = better).

4.0 CONCLUSION

This study carried out a detailed geotechnical, physico-chemical, and mineralogical assessment of the soils collected from the Ebenebe and Amansea borrow pits, the Onitsha river-bed sand, and the four laboratory blended samples. These tests give a detailed understanding of how each soil material behaves and their suitability for use as plaster soils. Based on the findings, the main conclusions are as follows:

1. All tested soil materials are highly siliceous (SiO_2 77.2–86.7 wt.%), quartz-dominated (86–96 wt.%), and contain very low fines (< 1 %), making them non-plastic to very low-plasticity sands (USCS SP). The high content of this oxide and mineral provides chemical inertness and good particle packing.
2. Grading characteristics are poorly graded but suitable for plaster: Uniformity coefficient (Cu = 3.4–4.6) and coefficient of curvature (Cc = 1.05–1.37) classified all samples as poorly graded sands (SP). Blending slightly improved Cu and Cc, contributing to higher MDD in sand-rich mixtures.
3. Pure borrow-pit soils retain more natural moisture (10.6–21.4 %) than Onitsha river-bed sand (2.1 %), because of the presence of kaolinite (3–7 %) and increased $Fe_2O_3 + Al_2O_3$ content.
4. Blending Onitsha river-bed sand with borrow-pit soils reduces fines content, kaolinite fraction, and water demand, while increasing maximum dry density and specific gravity in most cases. Also, blending reduces Fe_2O_3 + Al_2O_3 to 7.17–11.82 wt.% and raising specific gravity toward a suitable plaster soil range (2.50–2.70), lowering water demand and compacted density.

5. The ON60-AM40 blend exhibited high maximum dry density (1.86 Mg/m³), moderate grading (Cu = 3.5, Cc = 1.30), and reduced clay content compared with the pure Amansea soil, showing a favorable combination of properties for plastering. Its relatively low optimum moisture content (11 %) makes it easier to work with on site and less prone to shrinkage.

5.0 RECOMMENDATIONS

Based on the results of this study, the following recommendations are made:

1. Blending soil materials is highly recommended, this is because combining Amansea or Ebenebe borrow-pit soil, which are nearby, with Onitsha River sand improves plaster performance, controls fines and clay content, reduces shrinkage, and lowers overall cost by minimizing transportation cost.
2. The blend of 60% Onitsha river sand and 40% Amansea borrow-pit soil (ON60-AM40) is recommended as the most suitable combination for plastering based on its optimum characteristics.
3. Ebenebe soil (EB100) is not suitable for plastering due to high clay content and natural moisture, which increases water demand and shrinkage, leading to weak and crack-prone plasters.
4. Further studies should be done to evaluate plaster mortar made from the selected soil blends to assess strength, shrinkage, and durability under field conditions. Similar investigations across other parts of Anambra State are recommended.

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