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EXPLORING THE GEOTECHNICAL PROPERTIES OF SOIL IN AMASSOMA, BAYELSA STATE, NIGERIA FOR CLASSIFICATION PURPOSE USING THE UNIFIED SOIL CLASSIFICATION SYSTEMS

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ABSTRACT: Exploring the Geotechnical properties of soil in Amassoma, Bayelsa state to determine how soil behaviour influences the suitability of the soil for construction purpose. Soil classification indexes can be used to determine engineering properties such as drainage, compression and expansion characteristics of the soil. 6 soil samples collected at regular intervals of 1m, 2m, 2m, 4m, 5m and 6m was used for this investigation. Samples were subjected to laboratory analysis to determine their index properties. Sieve analysis test carried out showed in samples collected at 1m to 3m was composed of 70% sand and silt and less than 5% fines with no gravel content, samples collected at 4m and 5m was composed of 60% clay and silt and less than 5% sand, no gravel content was observed. The results from Atterberg experiment showed that the soil Liquid Limit(LL) for samples 1-3 ranges from 30.005-55.04%, Plastic Limit(PL) 24.42%-28.37% and Plastic Index(PI) 21.20%-21.50% while sample 4-6 is in the range of 50.42%-54.04% for Liquid Limit(LL), 30.53%-30.69% for Plastic Limit(PL) and 19.20%-19.25% for Plastic Index(PI). The moisture content ranges from 25.73%-38.265 for sample 1-3 and 29.19%-31.88% for sample 4-6 respectively. The results revealed that the Amassoma soil varies in their characteristics and pattern of distribution with respect to depth. The soil type in Amassoma is classified as siltysand, medium to high plasticity comprises inorganic silts and inorganic elastic clay based on the Unified Soil Classification System (USCS). This implies that the Amassoma soil is highly compressed and therefore is recommended for use for construction purposes.

Keywords: Soil Classification, Sieving, Atterberg Limit, Unified Soil Classification System

INTRODUCTION

The need for adequate and reliable geotechnical characterization of sub-soils is very important. This is because the impact of the imposed load is exacerbated by the thickness and consistency of the compressible layer (Oke and Amadi 2008), these in addition to other intrinsic factors contribute to the failure of civil engineering structures (Youdeowei and Nwankwoala, 2013, Amadi et al 2012). For the purpose of generating relevant data inputs for the design and construction of foundations for proposed structures, it is imperative that geotechnical characterization of sub-soil should investigated and ascertain the nature in which the soil is been classified.

Amassoma, the study area is characterized by the freshwater ecology of the upper reaches of the River Nun within the Niger Delta. It lies within the outcropping Benin Formation made up of continental deposits of Miocene to Recent Sediments. The area is associated with freshwater swamps, backswamps and meander belts of flat to sub-horizontal elevation. The study area is associated with several drainage problems with seasonal and temporal flooding as a result of heavy rainfall and rise in groundwater table.

Geotechnical information are useful in ensuring that the effects of projects on the environment and natural resources are properly evaluated and mitigated where necessary (Nwakwoala et al., 2009). Prior to construction, the properties of the soil must be evaluated as it is necessary for a geotechnical engineer to take this into account while in the design stage of a contruction work. This study is therefore aimed at exploring the geotechnical properties of Amassoma soil in Bayelsa State, for classification purpose in order to provide an integrated assessment of the geotechnical properties the soil.

Geomorphology and Geology

The study area is part of the Niger Delta that is located on the West Africa Continental margin. The tertiary Niger Delta covers approximately 2011,000 ^{2}KM and developed South-West ward. The knowledge of the geomorphological units of the Niger Delta today is derived mainly from the works of Allen (1968), Weber (1971). The topography of the study area is flat, slopping gently seawards. The study area is a low land area within the range of 0-20m above sea level and is drained and criss-cross by network of distributaries

(Youdoweiet al., 2012). The Niger Delta is a coursing upward regressive sequence of tertiary classic that prograded over the passive continental margin sequence of mainly cretaceous sediments.

Various forms of morphological units and depositional environments have been recognised in the study area, ranging from coastal flats, sand bars, ancient/modern sea, river and lagoon beaches, flood plains, seasonal flooded depressions, swamps, ancient creeks and river channels.

Table 1. Geologic units of the Niger Delta (After Akpokodje 1989)

GEOLOGIC UNITS	LITHOLOGY	AGE
Alluvium (general)	Gravel, sand, clay,silt	
Freshwater, backswamp meander belt	Sand, clay, some silt, gravel	
Saltwater, mangrove swamp and backswamp	Medium-find sand,clay and some silt.	Quaternary
Active/abandoned beach ridges	Sand clay and silt.	
Sambrerio-warri deltaic plain	Sand clay and silt.	
Benin formatioin (coastal plain sand)	Coastal medium sand; subordinate silt and clay lenes	Miccene - recent
Agbada formation	Mixtures of clay sand, and silt	Eocene-recent
Akata formation	Clay	paleocene

LOCATION OF THE STUDY AREA

The study area is within the Amassoma community in southern-Ijaw Local Government Area of Bayelsa Stae, Nigeria. The study area is found within longitude $5^{o}40$'E and $6^{o}00$'E and latitude$4^{o}20$'N and $5^{o}00$'N (fig1). The study area is located in the Niger Delta rain forest vegetative region and is basically accessible by a good road network and river system. It is traversed by tributries of the river Nun which drains the area.

MATERIALS AND METHODS

Investigation of the sub-soil of the study area was carried by analysing 6 soil samples from a borehole drilled by the hand auger. The samples were collected at regular intervals of 1m spacing from 1m to 6m depth. Detailed laboratory investigation was carried out on representative disturbed samples obtained from borehole for the classification test to ascertainLaboratory soil testing: The soil samples obtained from the borehole were subjected to both physical examination and laboratory testing. The laboratory analysis where carried out on representative samples in accordance with the America Society of for Testing and Materials (ASTM). These tests were carried out to give detailed and quantitative information concerning the soil nature on the basis of classification.

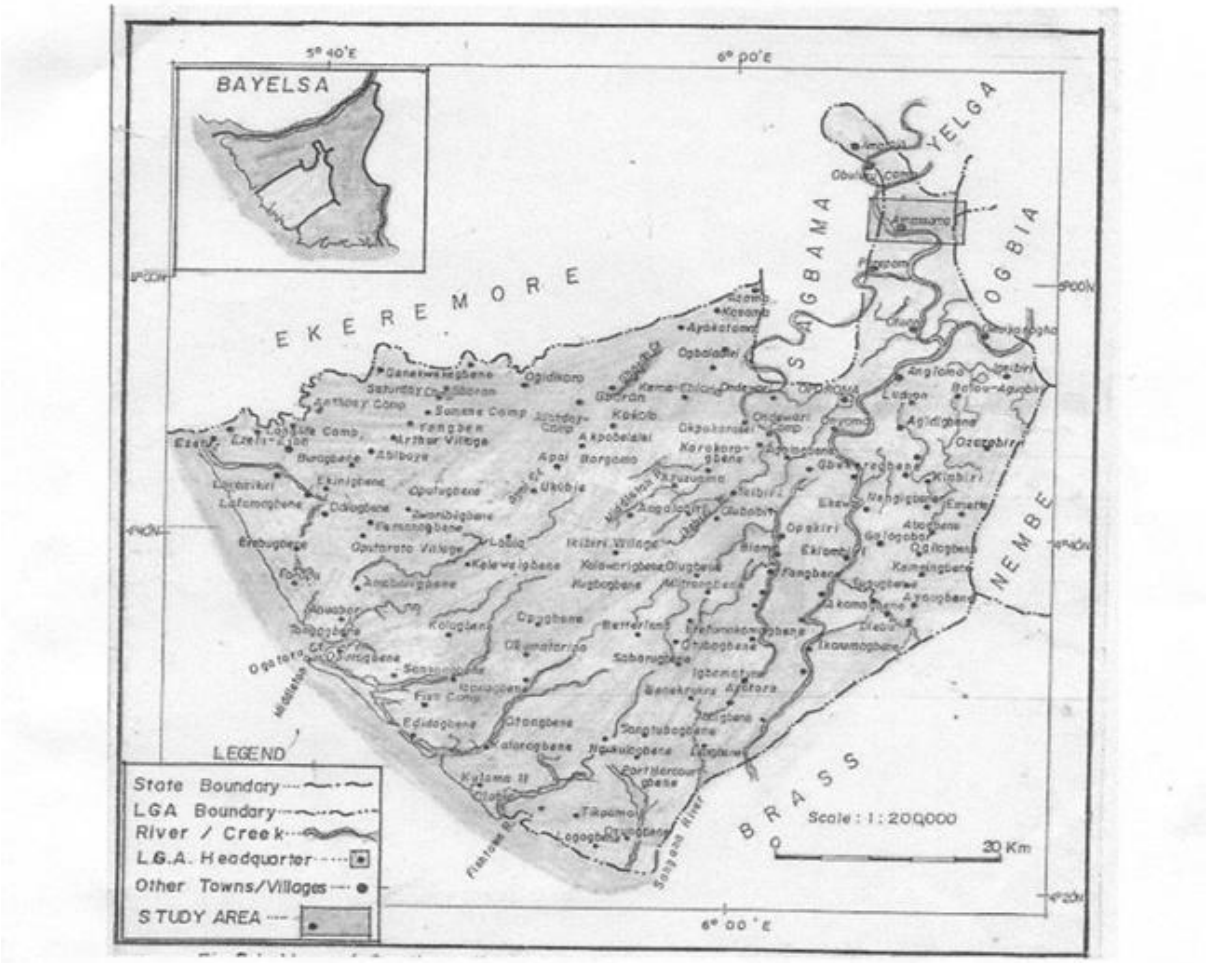

Fig. 1: Map of southern Ijaw Local Govt. Area showing the study area

RESULTS AND DISCUSSION

The Grain Size Distribution results showed the distribution of the soil. The soil types on the basis of unified soil classification system were classified as SM-silty sand. However, a different class of soil is obtained from both sieve analysis and Atterberg Limits.

Table 2 and table 3 shows the laboratory test result for PSD and Atterberg Limit

SAMPLE NO	FINES	SAND	GROUP SYMBOL	REMARK
1	21.31	78.69	SM	Sandy silt
2	47.73	52.27	SM	Sandy silt
3	41.20	58.80	SM	Sandy silt
4	32.69	67.31	SM	Silty Sand
5	63.80	36.20	SM	Silty Sand
6	63.68	36.32	SM	Silty Sand

Table 2: sieve analysis result chart
Table 3: Atterberg Limit Chart for the Samples

SAMPLE NO	DEPTH	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY LIMIT	MOISTURE CONTENT	GROUP SYNBOL	REMARK
1	1.0	55.04	24.78	30.26	38.26	ML	Inorganic Silt
2	2.0	51.27	24.42	26.85	25.73	ML	Inorganic Silt
3	3.0	30.00	28.37	1.63	31.71	MH	Elastic Clay
4	1.0	54.04	30.69	23.35	31.88	MH	Elastic Clay
5	2.0	53.07	30.59	22.48	32.20	MH	Elastic Clay
6	3.0	50.42	30.53	19.89	29.19	ML	Inorganic Silt

Atterberg Limits (also known as consistency limits) expresses the water adsorbing and absorbing ability of fine-grained, cohesive soils with the plasticity index indicating the range of water content through which the soil remains plastic. The Atterberg results on the basis of classification, shows that the soil Liquid Limit(LL) for sample 1-3 ranges from 30.005-55.04%, Plastic Limit(PL) 24.42%-28.37% and Plastic Index(PI) 21.20%-21.50% while sample 4-6 is in the range of 50.42%-54.04% for Liquid Limit(LL), 30.53%-30.69% for Plastic Limit(PL) and 19.20%-19.25% for Plastic Index(PI). The moisture content ranges from 25.73%-38.265 for sample 1-3 and
29.19%-31.88% for sample 4-6 respectively. The geotechnical results reveal that the Amassoma soil varies in their characteristics with respect to depth. The soil type in amassoma is classified as salty; medium to high plasticity comprises inorganic silts and inorganic elastic clay according to the Unified Soil Classification System (USCS).

CONCLUSION

The results from experimented values of Liquid Limits (LL), Plastic Limits (PL) and Plastic Index (PI) reveals that, the soil ranges from inorganic silts (ML) with slight plasticity to inorganic clay with high plasticity. Results reveal the soil samples encountered is good for civil engineering purposes because of the nature of the soil plasticity.
Generally, this study has shown the knowledge of the geotechnical characteristics of the area as obtained from field and laboratory analysis of recovered samples which have provided valuable data that can be used for foundation design and other forms of construction for civil structures in order to minimize adverse effects and prevention of post construction problems

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