AN INVESTIGATION OF GEOTECHNICAL PROPERTIES OF CHARO GREY SOIL AS A SUITABLE SUB GRADE MATERIAL IN ROAD CONSTRUCTION

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ABSTRACT

Construction of roads or any civil engineering structure over a loose soil caused many problems socially and economically due to its poor bearing capacity and non-plastic nature. Hence the study aims at investigating the geotechnical properties of Charo grey Soil in order to find out its suitability for road construction as a sub grade (local road). Five samples were collected from different pits located at distance interval of 250m, and at depth of 0.7-1.0m, through the disturbed sampling method. Several tests was carried out on the samples, the index properties of the soil show that they were non-plastic and classified as A-3 (fine sand) and CL (inorganic silty clay) using AASHTO and USCS respectively. However, the compaction characteristics indicate an increase in Maximum Dry Density (MDD) and decrease in Optimum Moisture Content (OMC) with higher compaction effort.

Keywords: *Investigation, Geotechnical Properties, Charo Grey Soil*

1.0 INTRODUCTION

High quality road networks are very important to the socio-economic development of any nation, especially developing country like Nigeria. (Akinleye and Tijani, 2017). According to Nwankwoala et al, 2014, “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). “This, in addition to other intrinsic factors contributes to the failure of civil engineering structures (Youdeowei and Nwankwoala, 2013; Amadi et al, 2012; Nwankwoala et al, 2014).

One of the primary tasks of a geotechnical engineer is to understand the character of the soils at a site. Soils, derived from the weathering of rocks, are very complex materials and vary widely. There is no certainty that soil in one location will have the same properties as the soil just a few centimeters away. Unrealized geological formations and groundwater conditions have been responsible for failures of many geotechnical systems and increased construction cost. According to Nwankwoala et al, 2014, “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). “This, in addition to other intrinsic factors contributes to the failure of civil engineering structures (Youdeowei and Nwankwoala, 2013; Amadi et al, 2012; Nwankwoala et al, 2014).

The bearing capacity is the most important soil property, which governs the design of foundation. Bearing capacity and the settlement are the two important parameters in the field of geotechnical engineering. Civil engineering projects such as buildings, bridges, dams and roadways require detailed subsurface information as part of the design process. Bearing capacity is affected by various factors like change in level of water table, eccentric loads, inclined loads, dimensions of the footings, etc. (Asakereh et al, 2015).

However, paved and feeder roads construction over loose soil deposit could pose a serious problem for an effective motor ability due to low bearing capacity non –plastic nature of the soil. (Kundiri et al, 2016).

2.0 MATERIALS AND METHOD

The soil samples was collected from five different locations designated as L1-L5 along the soil of Kano (latitude and longitude), at an interval of 250m and at average depth of 0.7-1.0m using the method of disturbed sampling. The soil was then preserved in plastic bags to avoid loss of moisture and transported to the laboratory for tests.

Laboratory Tests Conducted

The tests were conducted based on procedures in BS 1377 (1990). The tests include Atterberg limits, grading characteristics, specific gravity, Particle size distribution, and compaction test. The compaction test was carried out using 2.5 kg rammer falling 30.0cm onto three layers, each layer receiving 25 blows, respectively (Ola, 1978; Osinubi, 1998).

3.0 RESULT AND DISCUSSION

The results obtained were tabulated in Table1 below.

Table 1: Engineering properties of sample A, B, C, D &E

S/N	Property		Sample A	Sample B	Sample C	Sample D	Sample E
1	Natural Moisture Content (%)		2.85	3.97	2.77	4.58	6.33
2	Liquid limit		11.45	11.79	12.18	11.75	11.24
3	Plastic Limit		-	-	-	-	-
4	Plasticity Index		-	-	-	-	-
5	Max Dry Density		1.855	2.0	1.99	1.77	1.82
6	Optimum Moisture content		10.7	10.2	9.89	14.0	12.01
7	Percentage Passing sieve No. 200		97.40	97.15	97.35	96.97	97.25
8	Specific Gravity		2.45	2.43	2.52	2.19	2.15
9	Classification	AASHTO	A-3	A-3	A-3	A-3	A-3
		USCS	CL	CL	CL	CL	CL

The index properties of the Charo grey soil showed that, the low values of specific gravity ranging from 2.15 to 2.52, suggested the presence of organic matter in the soil. The plasticity characteristics show that the soil samples are non – plastic with a liquid limit of 11.24 – 12.18%. The soil samples were classified as A – 3 (fine sand) and CL (in organic silty clay) according to AASHTO and USCS methods of classification respectively (AASTHO, 1986; Das, 2006).
The natural moisture content gives the moisture content of the soil in-situ. From table A1, the moisture content for sample A, B, C, D & E are 3.97%, 2.85%, 2.77%, 4.58% & 6.33% respectively. Therefore it is expected that however during the raining season the moisture content will increase up to two times this value depending on the intensity of the rain and drainage conditions.

The plasticity which is an important characteristic of fine soil is the ability of a soil to undergo an unrecoverable deformation without cracking and they were all determined to be 0.

4.6 Particle Size Distribution

Using the American Association of State Highway and Transport Officials (AASHTO), the soil was classified on the basis of its plasticity and liquid limit since more than 50% soil samples pass through sieve No. 200 (0.075), the soil was classified as A-3. This shows that the soil is either a fine sand soil. The liquid limit for the samples which is less than 50% indicates that the soil is of low plasticity.

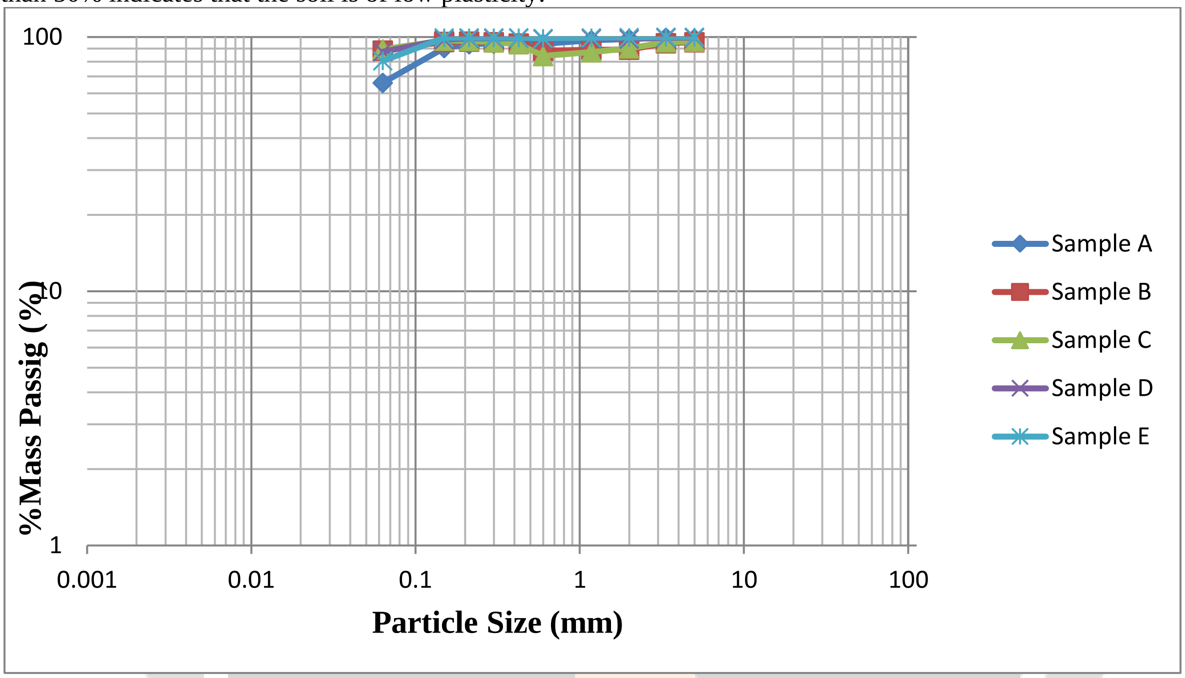

FIGURE 1: Grain Size Distribution

3.2 Compaction Characteristics

The Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) of the soils were observed to be within the range of 1.77 – 2.0Mg/m3 and 9.89 – 14.0% respectively for all compactive efforts. The compactive behaviour of the Charo grey soil is depicted in figures 2 to 4 for the five different samples.

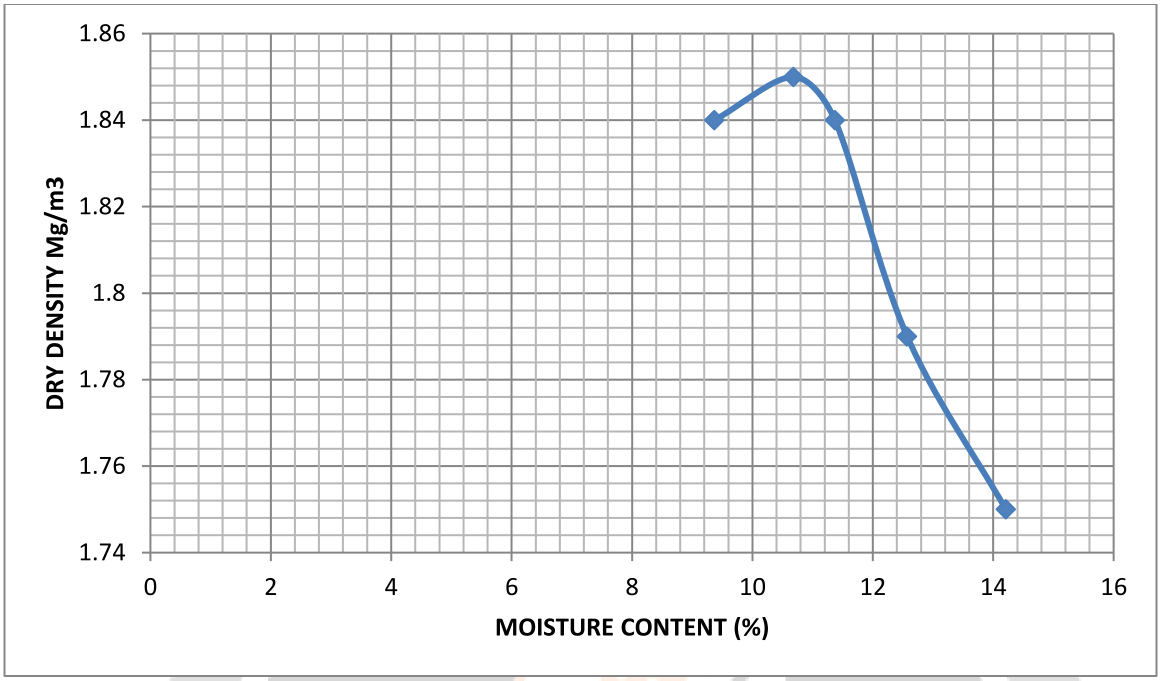

FIGURE 2: Sample A Compaction Test

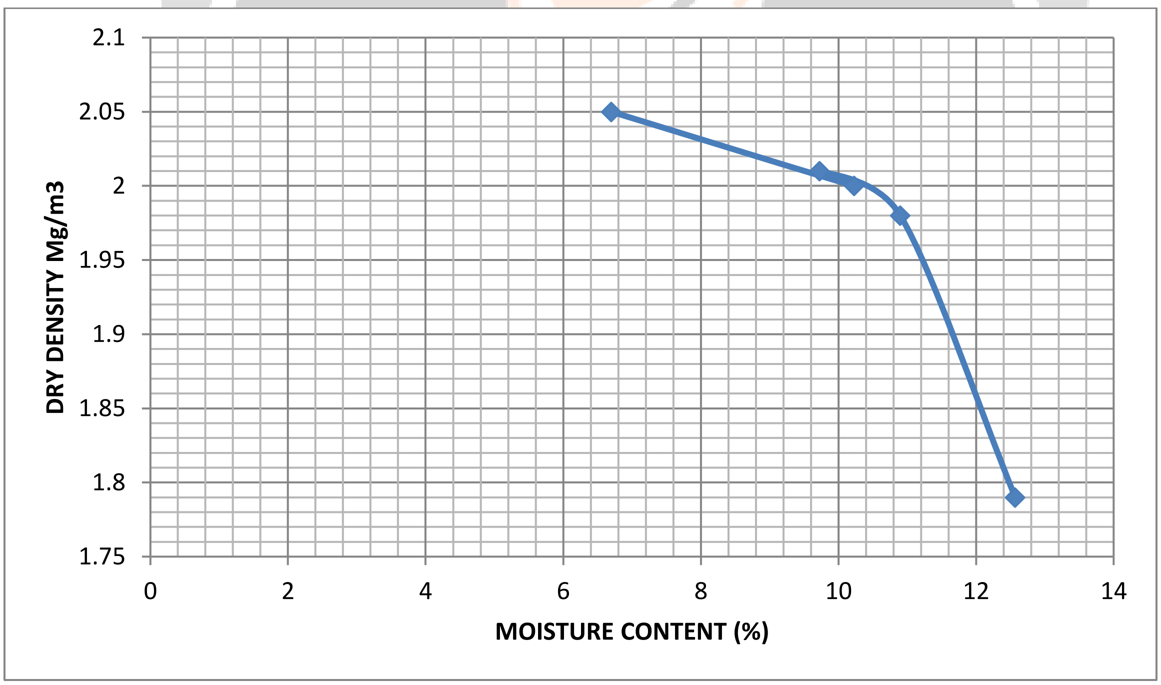

FIGURE 3: Sample B Compaction Test

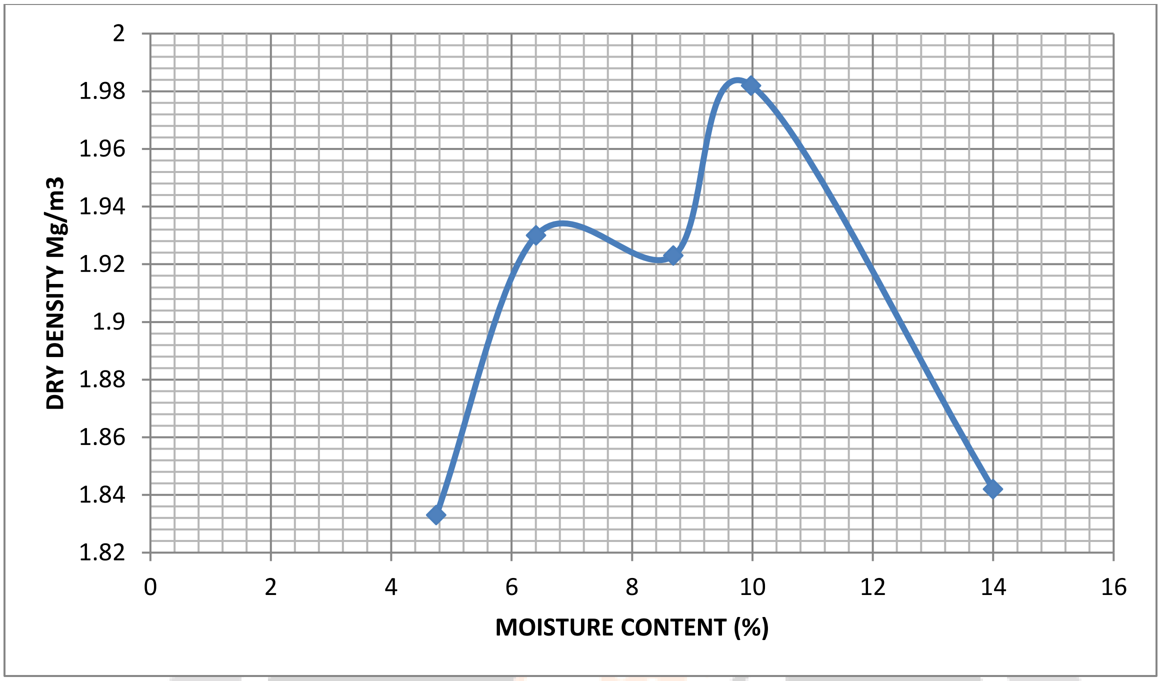

FIGURE 4: Sample C Compaction Test

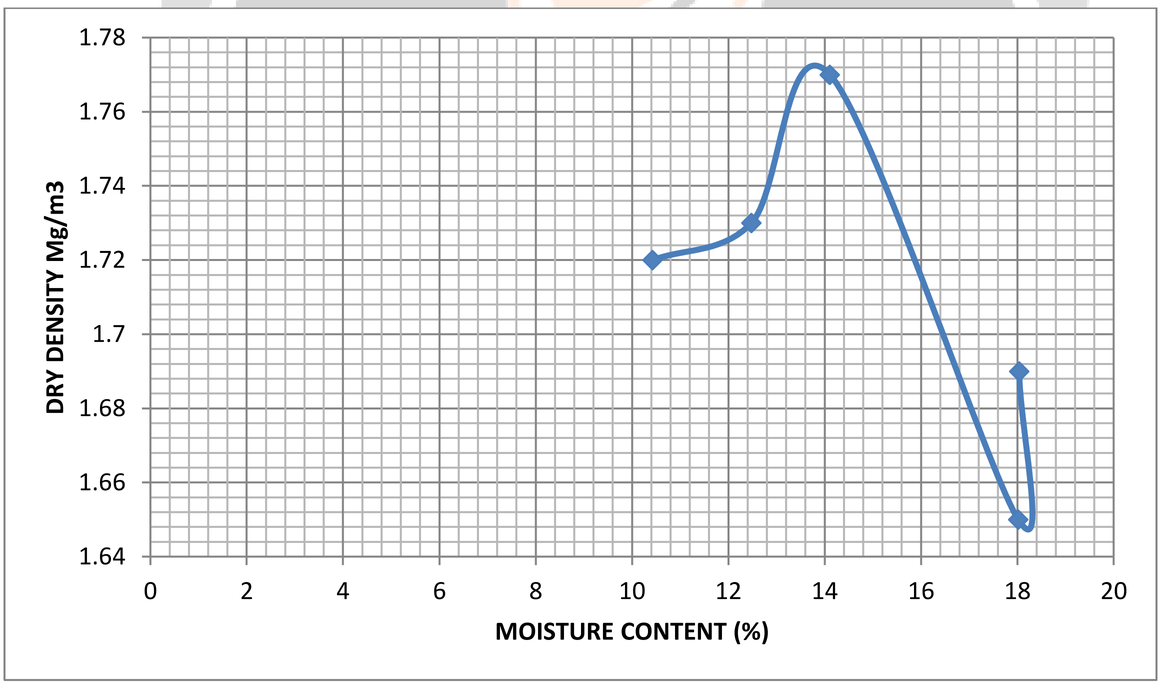

FIGURE 5: Sample D Compaction Test

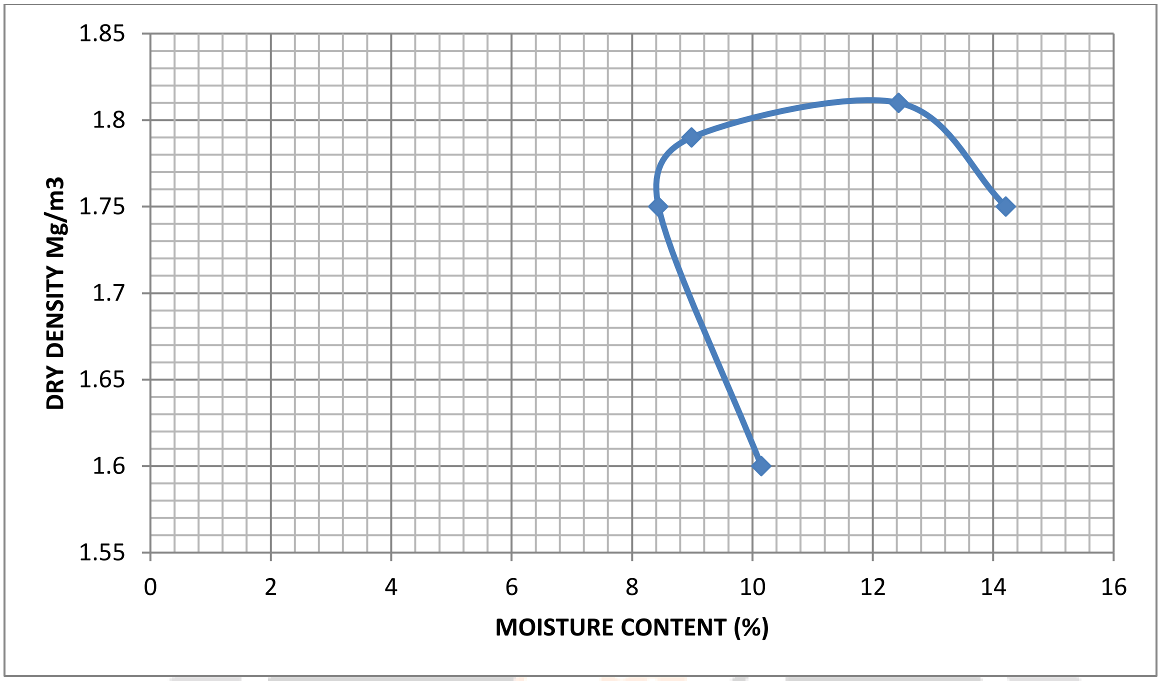

FIGURE 6: Sample E Compaction Test

The patterns of the MDD and OMC indicated that higher compaction vitality brought about higher dry densities, while the OMC diminishes as the compactive effort fluctuates. It could be derived that higher MDD values could be because of increased penetration of the compaction rammer on soil surface, bringing about nearer arrangement of particles along the surface, yielding more noteworthy density. This is in concurrence with discoveries introduced in different investigations (Daniel and Wu, 1993).

6.0 CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

sFive samples each were collected at a depth of 1.0m for the whole research from the site. Based on the analysis of the results the following conclusions were drawn.

It was found that the samples contain more than 90% passing sieve no. 200 the liquid limit were found to be 11.45%, 11.79%, 12.18%, 11.75% and 11.24% for sample A, B,C, D and E respectively. While in the same vein the plastic limit was zero 0% for A, B, C, D and E due non-plastic nature of the samples. The soil samples were also classified into various group index (A-3) in AASHTO (find sand), (CL) in USCS and were all rated to be fair to poor.

6.2 RECOMMENDATION

However, in view of the above conclusion, the characteristics of this soil shows that, it cannot effectively serve as a suitable sub grade material in road construction without improving the quality of the soil due to its non-plastic nature and poor bearing capacity.

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