International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 2 Issue 8, August - 2013

Geotechnical Mapping of Federal University of Technology (now MAUTECH) Yola Site, Nigeria.

Jacob Alheri, Department of Civil Engineering.
Federal Polytechnic Mubi, Adamawa State, Nigeria.

Mathias Yakubu, Department of Civil Engineering,
Federal Polytechnic Mubi, Adamawa State, Nigeria.

B.G. Montang, Department of Civil Engineering.
Federal Polytechnic Mubi, Adamawa State, Nigeria.

ABSTRACT

The research focused on soil samples collected within MAUTECH (Modibo Adama University of Technology). Yola to examine its properties by conducting laboratory test. Nine (9) samples representing the MAUTECH site were considered. The laboratory test revealed that the maximum values of 30.5% and 13.2% were obtained for liquid limit and plasticity index respectively. Maximum and minimum values of 67.2%, 880kN/m^2 and 4.0%, 94kN/m^2 were recorded for CBR and UCS respectively. Samples 1,5 and 8 were classified as A-2-4 subgroups, sample 3 as A-2-6 subgroup while samples 2, 6 and 4,7,9 as A-4 and A-6 respectively.

INTRODUCTION

The engineering properties of soil based on knowledge of the effect of environmental variables on soil formation have always been the basis for all geotechnical mapping. All approaches to geotechnical mapping of soil rest on the ability to use knowledge of the process of soil genesis to predict the properties of soils at any point in the landscape. The research show the various types of soil found around MAUTECH site.

The soils in MAUTECH are not explored and are subject to future development, therefore the need to know the index/ strength properties of soils within the site for future use and to have a full knowledge of its usefulness as construction materials in their natural state or to be modified for construction purposes if found deficient.

LOCATION & GEOLOGY OF THE STUDY AREA

The soil samples used for this research were collected at MAUTECH located on latitude 09.14^{o}N and longitude 12.8^{o}E that is located on Bima sandstone and river alluvium. The annual average temperature for Yola ranges between 17^{o}C – 43^{o}C while the annual rainfall is about 958.99mm (Adebayo, 1990).

Table 1:Description of the Geology of the Study Area where Samples were collected

PITS	LOCATION
P1	110m North of Green House & 500m from the right boundary
P2	200m North of Block K & 500m West of P1
P3	500m North of SMIT & 500m West of P2
P4	500m West of P3, 500m North of P7 & 500m East of P5
P5	500m West of P4& 500m North of P6
P6	500m South of P5, 500m West of P7 & 500m South of P8
P7	500m West of SMIT, 500m South of P4 & 500m East of P6
P8	500m South of P6 & 500m West of P9
P9	500m South of P7 & 500m East of P8

METHODOLOGY

All the methods used for the laboratory test of the soils were in accordance with BS 1377 (1990) This research carried out some basic laboratory test such as compaction test using British Standard Light (BSL), West African Standard (WAS), British Standard Heavy (BSH) methods, Atterberg's limit, sieve analysis, free swell, pH value, specific gravity, California bearing ratio (CBR), and Unconfined Compressive Strength (UCS) test. The samples were collected at different locations of 500m intervals by disturbed method of sample collection. The samples were collected at the depth of 0.5 – 0.9 m. it was extracted using manual labour and equipment such as shovel, digger and measuring tape. Part of the samples were collected and placed inside plastic for natural moisture content test while the remaining was placed inside sacks. It was taken to soil laboratory for analysis.

TEST RESULTS AND DISCUSSION

The variation in the natural moisture content is presented in Table 2 pit 8 which clayey gravel has the highest value of moisture content. The liquid limits of the soil samples ranges between 20 to 35% with exception of pit 8 which has less than 20%. The nine samples tested with linear shrinkage of less than 15% which means the degree of expansion and the danger of severity is low and non-critical respectively. The variation in the optimum moisture content (OMC) and maximum dry density (MDD) with compactive efforts are presented in Fig1 – Fig 27 and in Table 5. The OMC generally decreased with increased compactive efforts while MDD increased with increased compactive efforts. This observation agrees with usual decrease in OMC with increase in MDD and compactive efforts respectively. The CBR values of the nine samples are presented in Table 6. The variations in the CBR values with compactive effort are proportional for the whole samples. Increased in compactive effort increased the CBR values. This is usually associated with increasing dry densities or due to the development of cohesive forces between soil samples. The values obtained for specific gravity of the samples are presented in Table 2. The values shows that the soils contained no organic matter (i.e. Gs values > 2.0)

The pH values are also in Table 2. The soil sample from pit 8 which belong to A-2-4 subgroup has the highest pH value whereas soil from pit 1 of the same group A-2-4 has the lower pH value. This however means that the soil of the same group or subgroup may or may not have the same pH values. The soils are said to be basic (non acidic). The variation in the free swelling for both ordinary and distilled water is shown in Table 3. The potential of swelling is more in ordinary water than the distilled water. The swelling potentials for the soil samples are generally moderate. The values of the unconfined compressive strength of the samples are shown in Table 7. The UCS value for all the samples varies with compaction effort. The UCS value of 880kN/m^2 and 94kN/m^2 were obtained as maximum and minimum respectively which indicate that most of the soils are suitable.

Table 2:Natural MoistureContent, Specific Gravityand pH

Pit No.	1	2	3	4	5	6	7	8	9
W (%)	7.10	10.00	9.9	8.80	5.80	6.00	9.10	10.10	7.80
Gs	2.51	2.56	2.57	2.62	2.59	2.57	2.58	2.61	2.57
pH	4.30	5.30	3.99	5.22	3.94	4.36	3.98	5.61	5.00

Table 3:Free Swelling

Pit No.	1	2	3	4	5	6	7	8	9
Ordinary	5.0	5.5	5.0	5.0	2.0	5.0	5.0	5.0	5.5
Distilled	1.0	3.0	1.0	2.5	1.5	2.0	5.0	5.0	5.0

Table 4:Results of Atterberg's Limit

Pit No.	LL (%)	PL (%)	PI (%)	LS (%)
1	24.30	16.00	8.30	1.43
2	23.50	19.20	4.30	2.86
3	25.00	14.00	11.00	3.57
4	21.50	8.80	12.70	4.29
5	21.80	14.60	7.20	3.57
6	20.80	11.50	9.30	5.71
7	26.50	13.70	12.00	5.00
8	14.00	11.10	2.90	2.14
9	30.50	17.30	13.20	6.43

Table 5: Compaction Test Results

Pit No.	BSL		WASC		BSH	
	MDD	OMC	MDD	OMC	MDD	OMC
1	2.00	12.00	2.00	9.10	2.01	9.00
2	2.00	10.33	2.00	9.65	2.02	9.00
3	1.90	12.78	2.00	10.63	2.00	10.20
4	1.93	10.72	2.01	10.40	2.04	9.50
5	2.06	9.40	2.08	8.89	2.14	6.60
6	1.97	11.30	2.05	9.30	2.10	8.84
7	1.87	12.30	2.01	11.11	2.04	9.60
8	2.09	9.00	2.09	8.80	2.14	8.60
9	2.00	9.90	2.06	9.00	2.10	8.70

Table 6: California Bearing Ratio Test Result

Pit No.	CBR @	BSL		WAS		BSH	
		Top	Bottom	Top	Bottom	Top	Bottom
1	2.5mm	13.0	21.0	13.2	22.1	18.4	19.9
	5.0mm	14.2	21.0	16.7	24.0	19.6	23.0
2	2.5mm	7.4	7.0	9.6	10.3	9.2	11.0
	5.0mm	7.4	7.1	10.0	11.0	10.8	13.5
3	2.5mm	3.0	4.0	3.3	4.8	13.2	12.5
	5.0mm	3.4	4.0	3.4	5.1	14.2	13.5
4	2.5mm	3.0	3.8	5.9	6.6	7.4	10.3
	5.0mm	4.4	5.0	6.4	7.4	7.4	12.3
5	2.5mm	6.0	9.6	8.1	19.1	16.9	45.6
	5.0mm	8.3	14.2	12.2	21..6	32.8	67.2
6	2.5mm	5.1	6.3	27.2	28.0	28.3	28.7
	5.0mm	5.9	6.6	27.4	15.7	29.4	30.9
7	2.5mm	6.3	16.5	12.9	18.1	10.7	19.9
	5.0mm	6.9	17.2	16.2	4.4	16.2	22.5
8	2.5mm	3.3	3.0	4.0	5.4	5.1	5.1
	5.0mm	4.4	4.0	5.0	7.4	7.4	6.4
9	2.5mm	4.4	4.8	4.8	7.4	9.6	10.0
	5.0mm	5.9	6.1	5.9		12.7	13.2

Table 7: Unconfined Compressive Strength (UCS) Test Result in kN/m^2

Pit	1	2	3	4	5	6	7	8	9
BSL	157	126	126	220	251	220	220	94	126
WAS	471	132	157	377	503	567	534	126	220
BSH	786	189	189	503	880	597	754	189	251

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 2 Issue 8, August - 2013

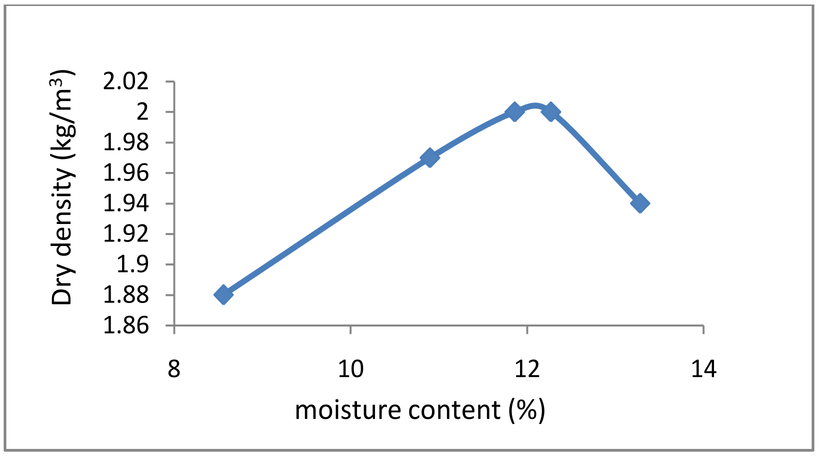

Figure1: Pit No. 1: BS Light (BSL) method of compaction

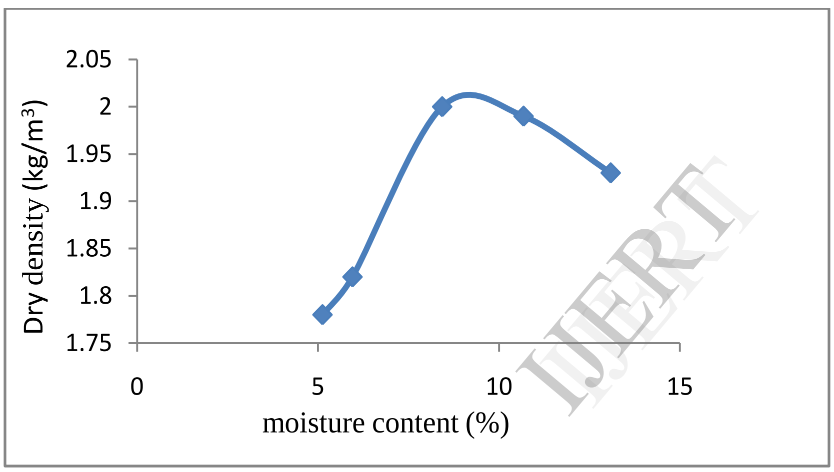

Figure1: Pit No. 2: West African Standard (WAS) method of compaction

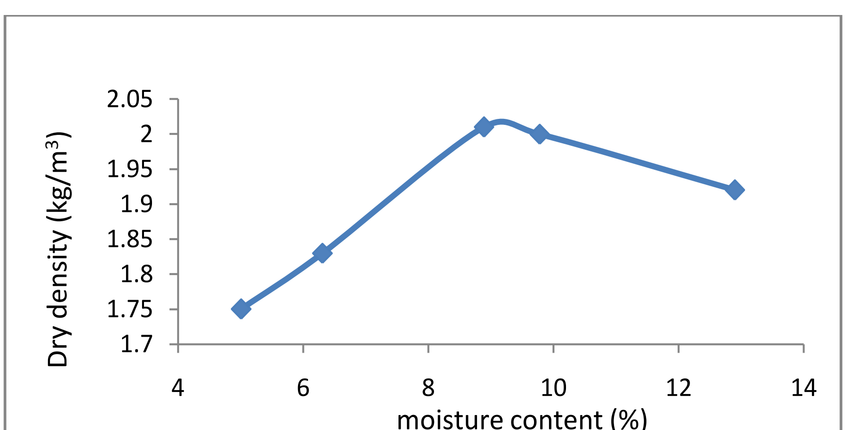

Figure1: Pit No. 3: BS Heavy (BSH) method of compaction

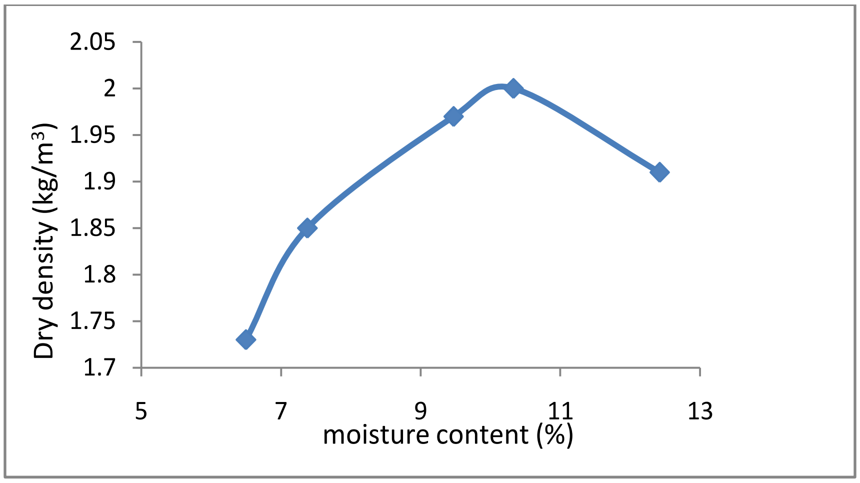

Figure1: Pit No. 4: BS Light (BSL) method of compaction

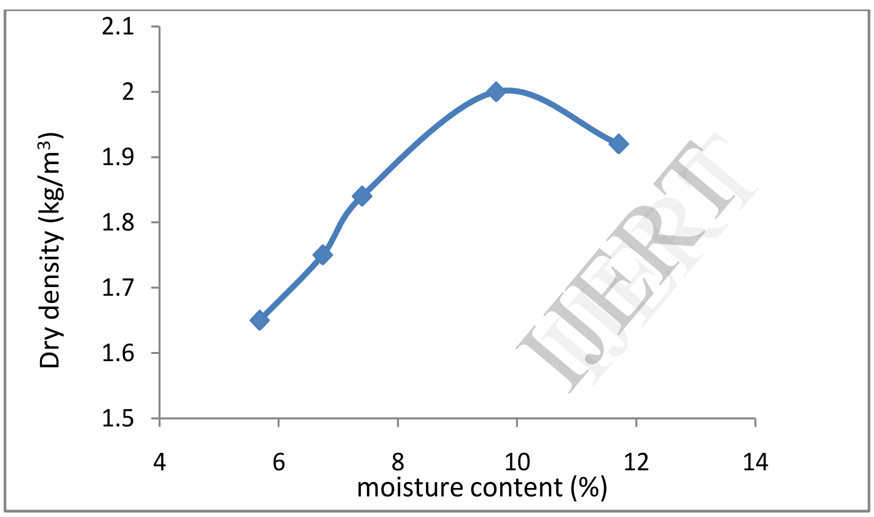

Figure1: Pit No. 5: West African Standard (WAS) method of compaction

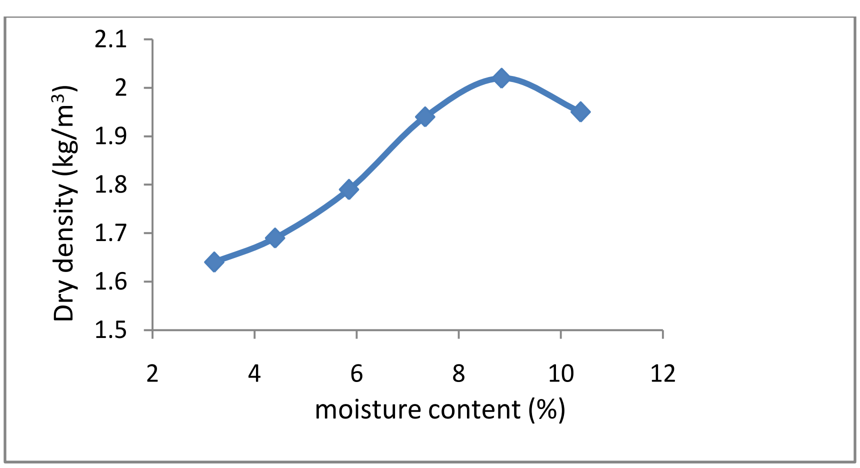

Figure1: Pit No. 6: BS Heavy (BSH) method of compaction

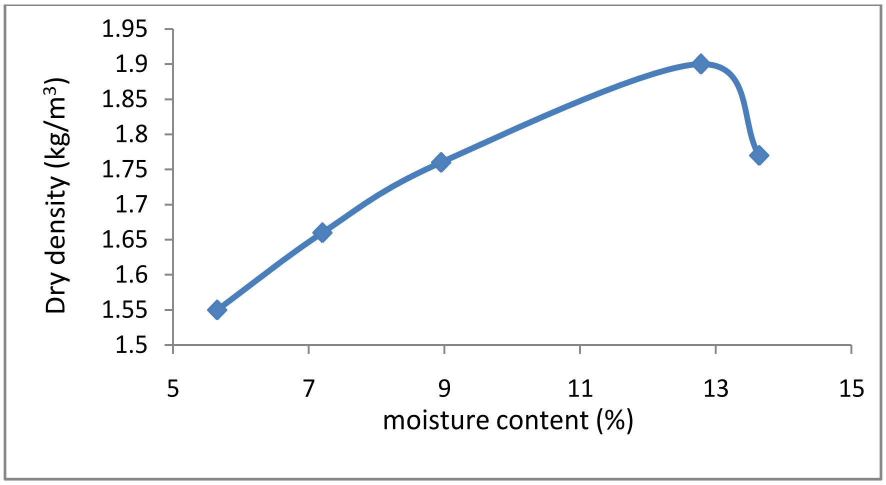

Figure1: Pit No. 7: BS Light (BSL) method of compaction

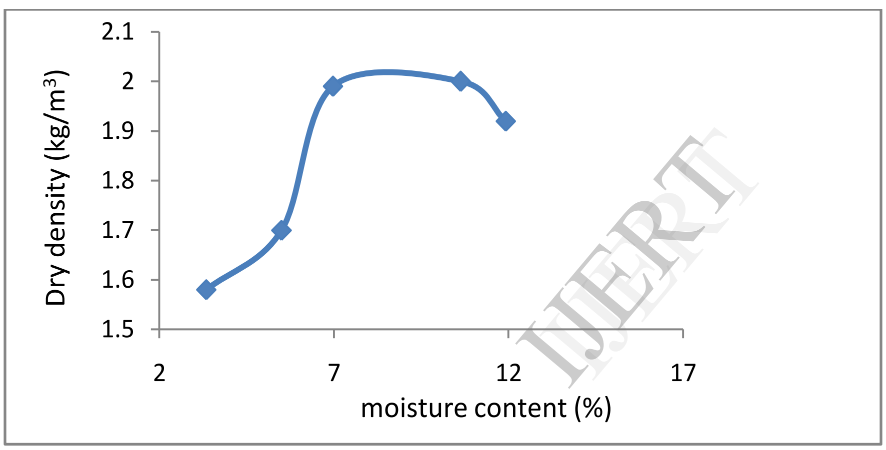

Figure1: Pit No. 8: West African Standard (WAS) method of compaction

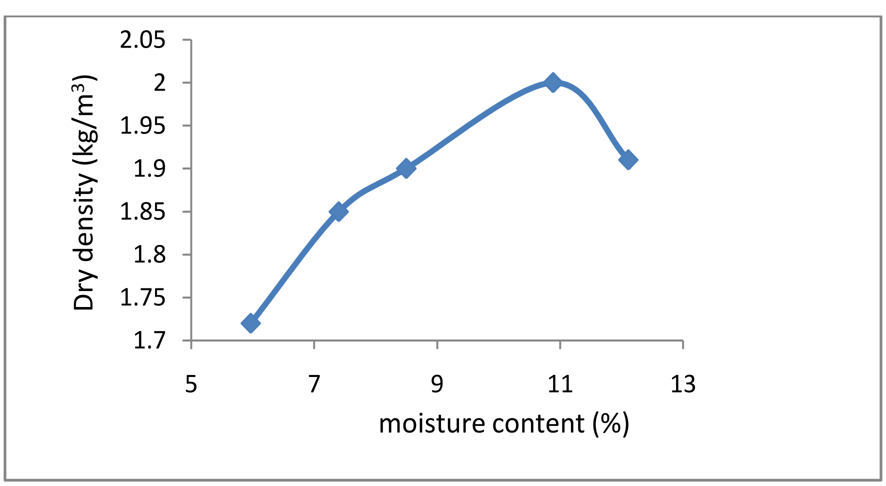

Figure1: Pit No. 9: BS Heavy (BSH) method of compaction

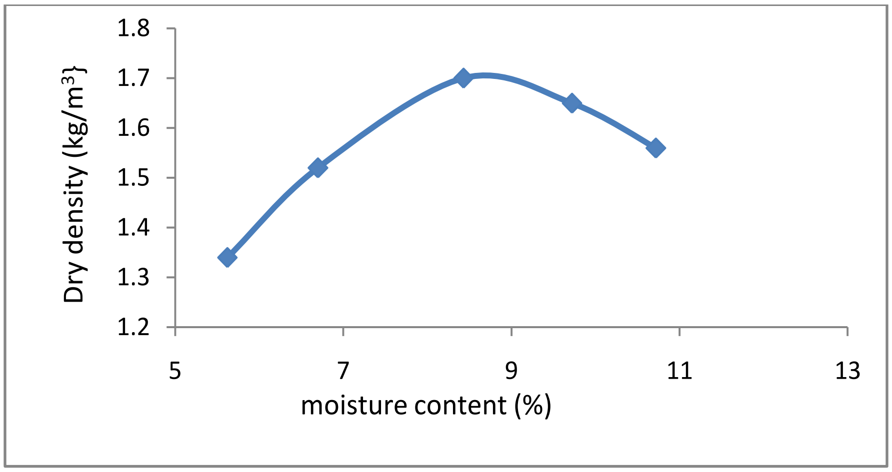

Figure1: Pit No. 10: BS Light (BSL) method of compaction

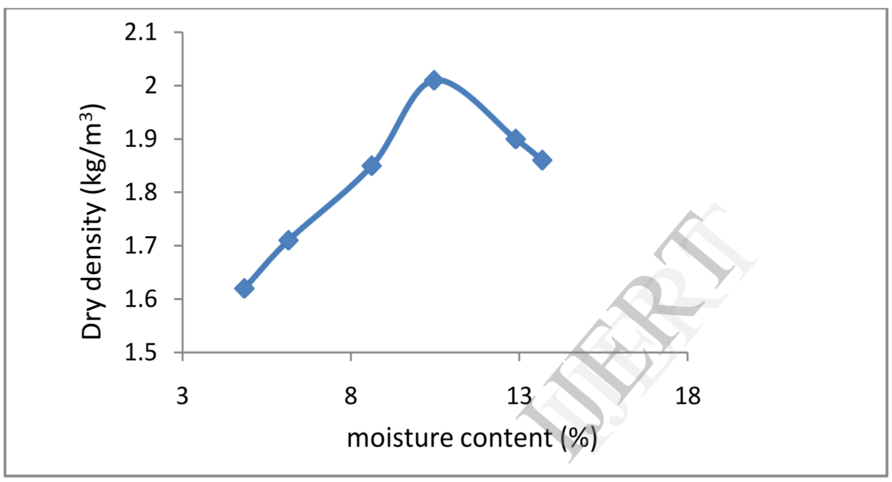

Figure1: Pit No. 11: West African Standard (WAS) method of compaction

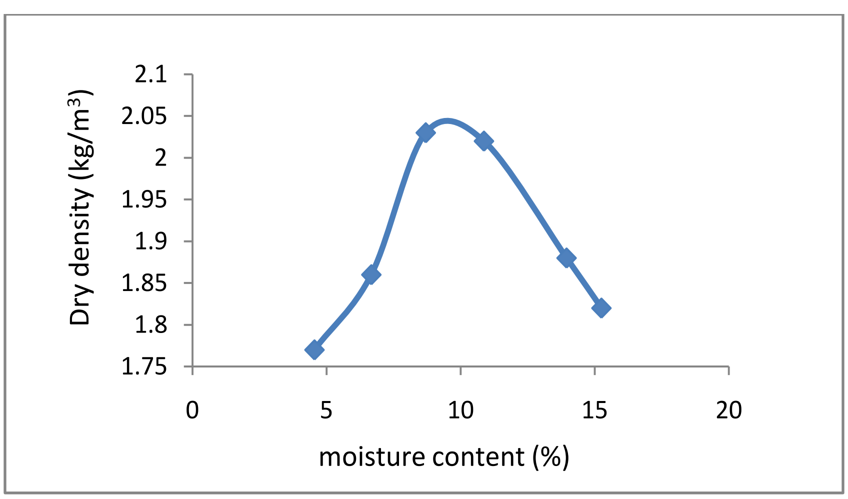

Figure1: Pit No. 12: BS Heavy (BSH) method of compaction

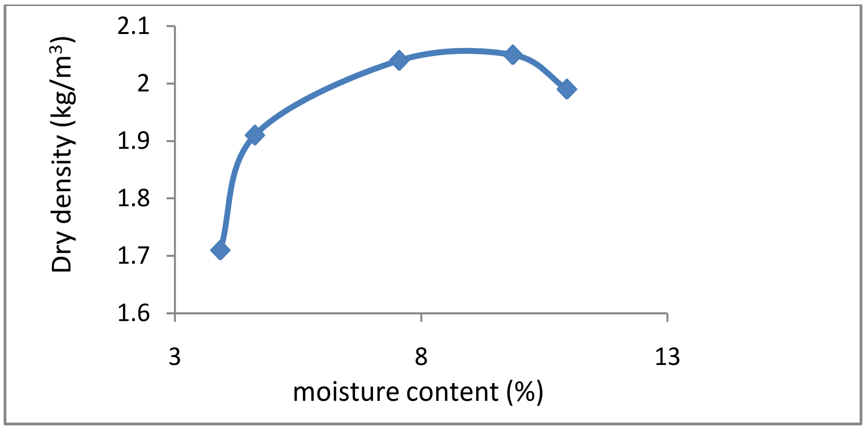

Figure1: Pit No. 13: BS Light (BSL) method of compaction

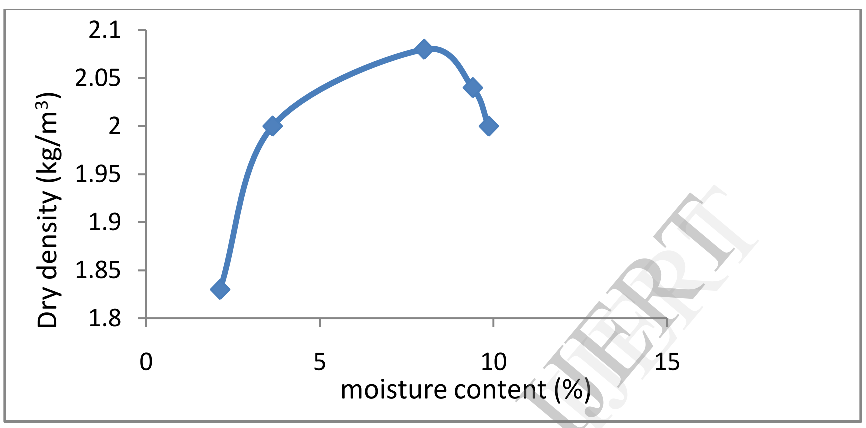

Figure1: Pit No. 14: West African Standard (WAS) method of compaction

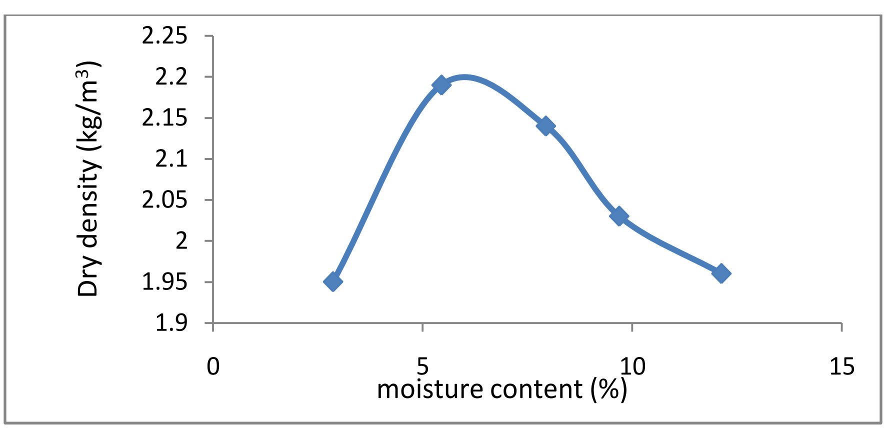

Figure1: Pit No.15: BS Heavy (BSH) method of compaction

ISSN: 2278-0181
Vol. 2 Issue 8, August - 2013

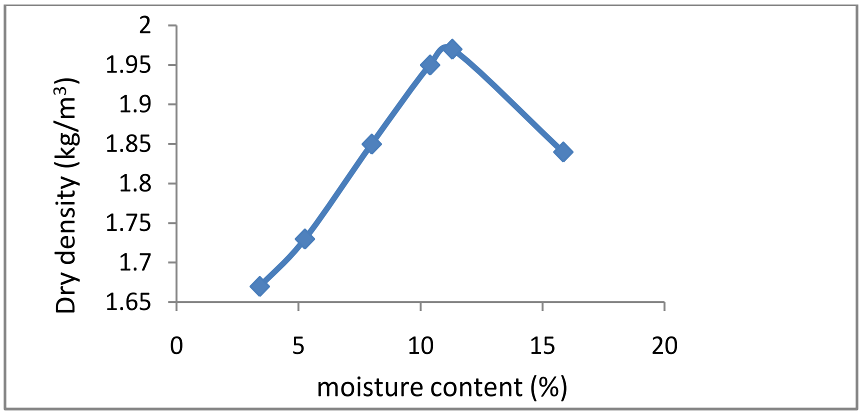

Figure1: Pit No.16: BS Light (BSL) method of compaction

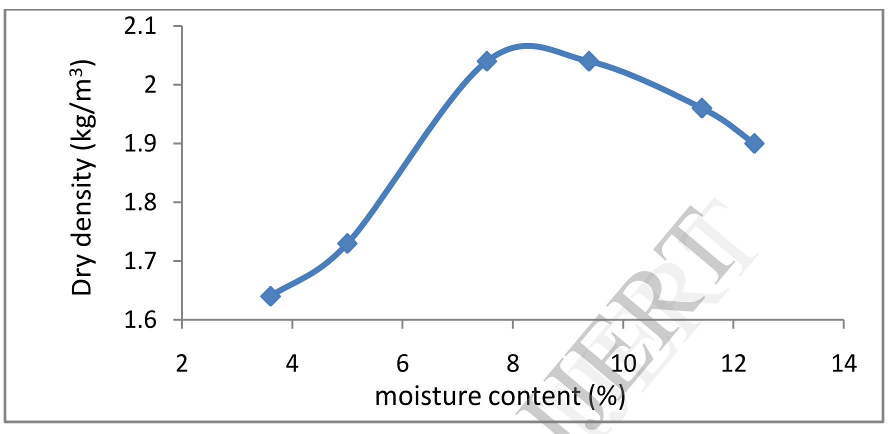

Figure1: Pit No. 17: West African Standard (WAS) method of compaction

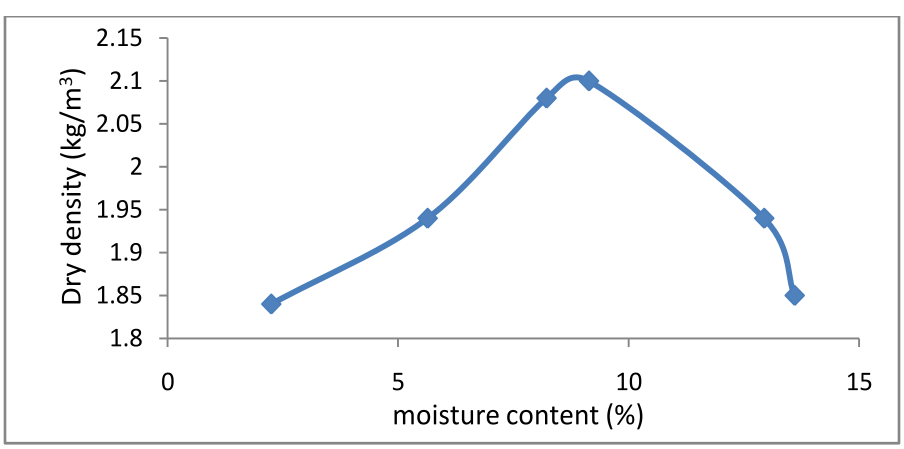

Figure1: Pit No. 18: BS Heavy (BSH) method of compaction

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 2 Issue 8, August - 2013

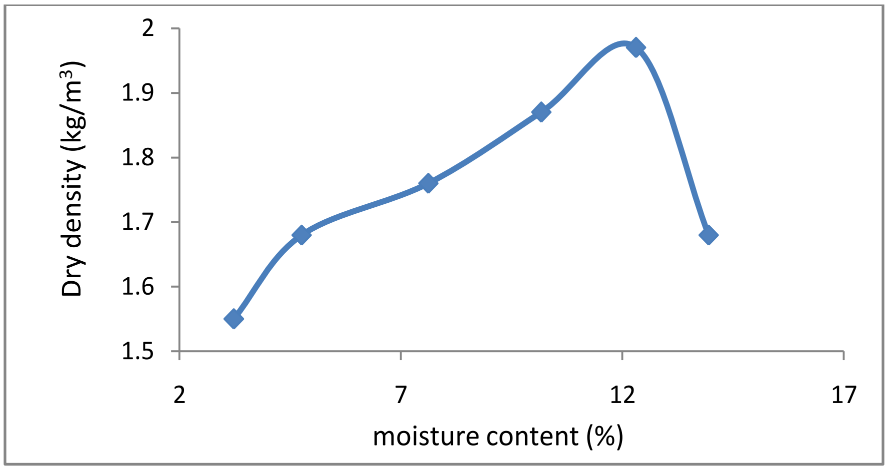

Figure1: Pit No. 19: BS Light (BSL) method of compaction

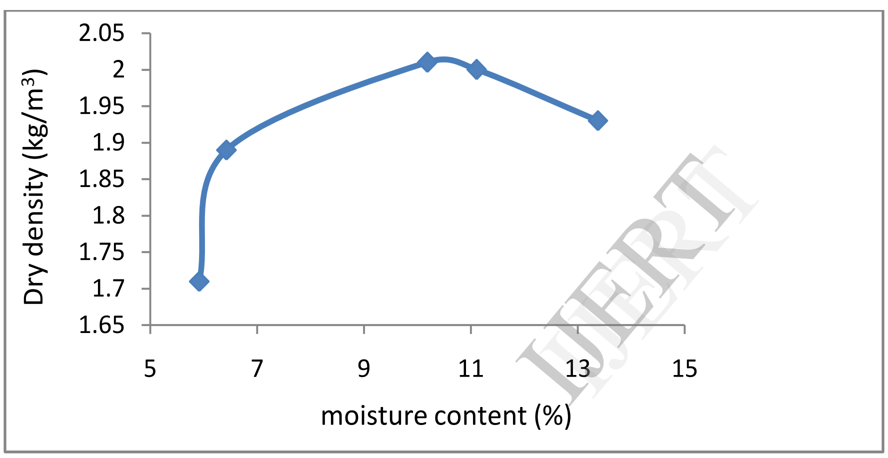

Figure1: Pit No. 20: West African Standard (WAS) method of compaction

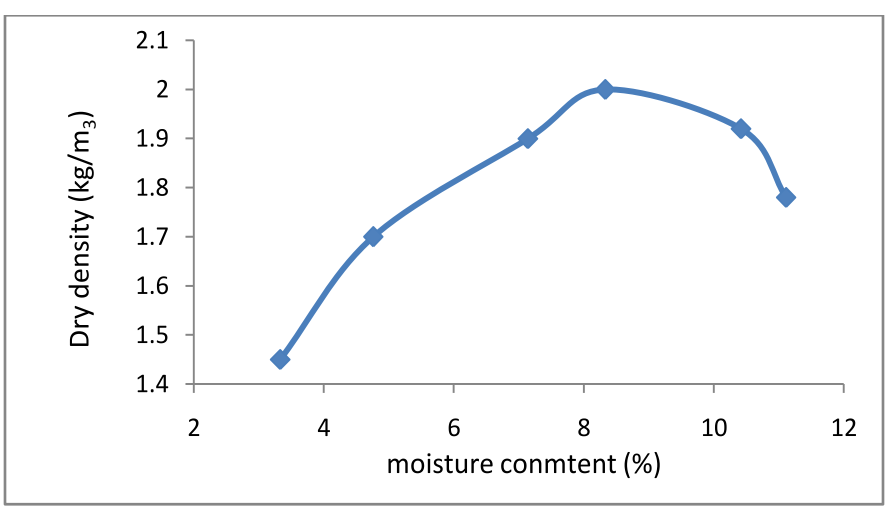

Figure1: Pit No. 21: BS Heavy (BSH) method of compaction

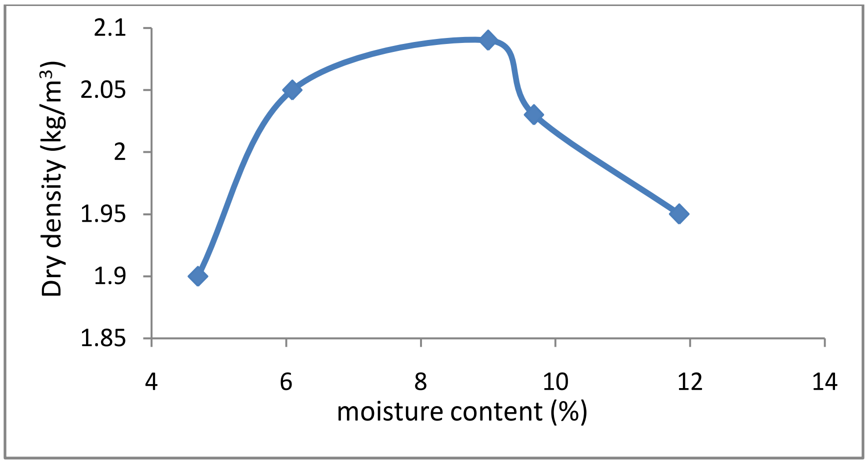

Figure1: Pit No. 22: BS Light (BSL) method of compaction

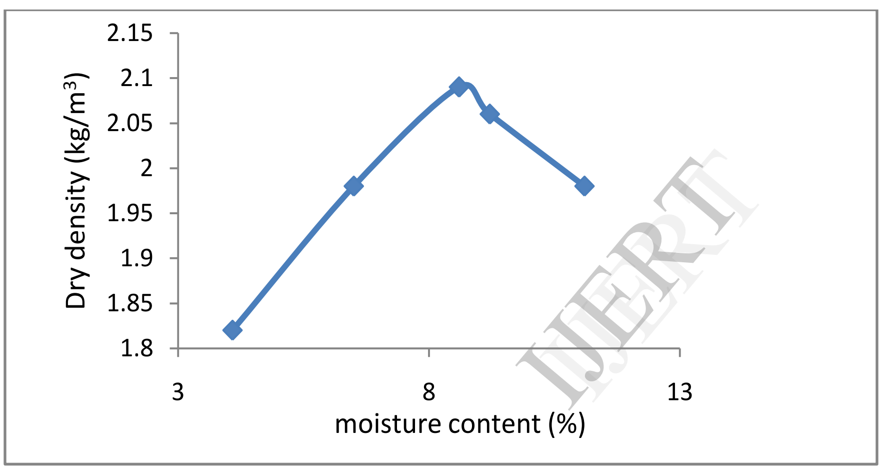

Figure1: Pit No. 23: West African Standard (WAS) method of compaction

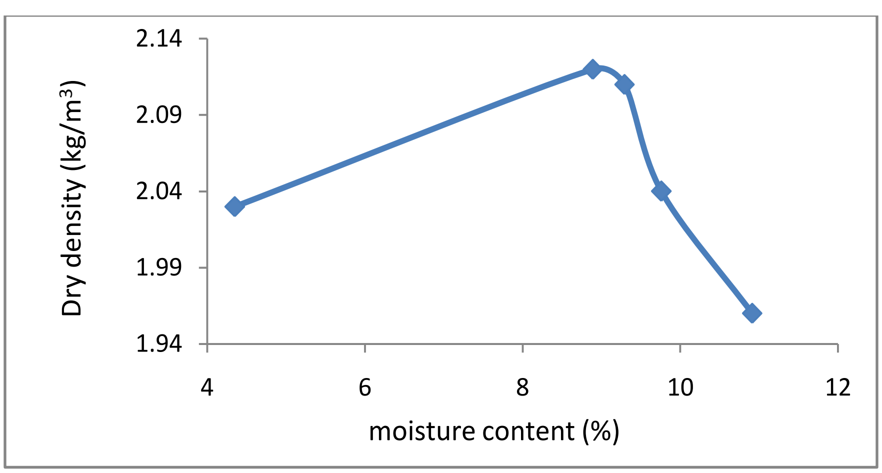

Figure1: Pit No. 24: BS Heavy (BSH) method of compaction

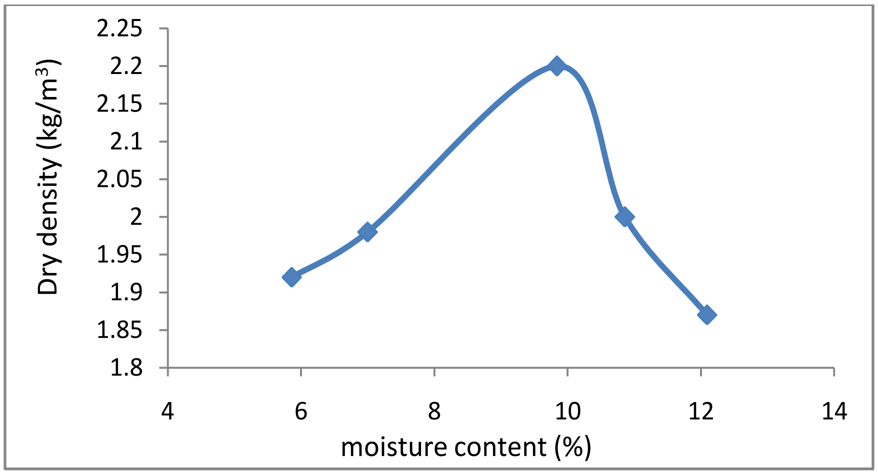

Figure1: Pit No. 25: BS Light (BSL) method of compaction

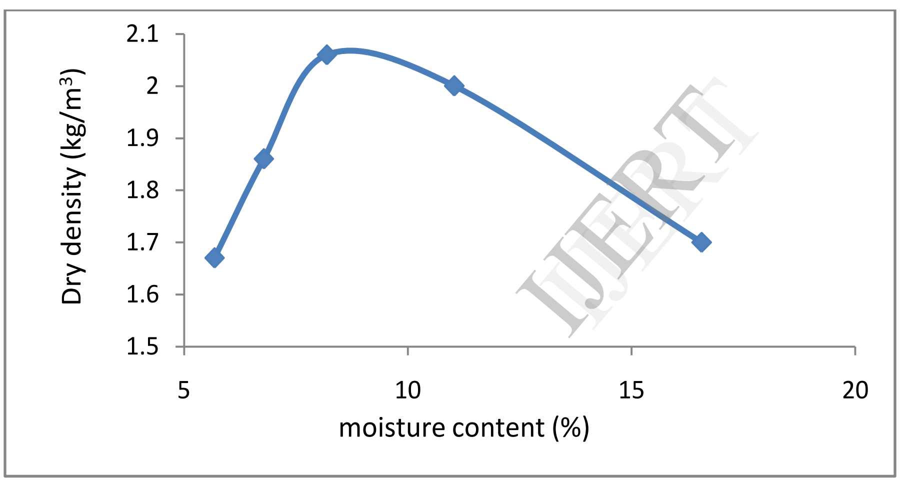

Figure1: Pit No. 26: West African Standard (WAS) method of compaction

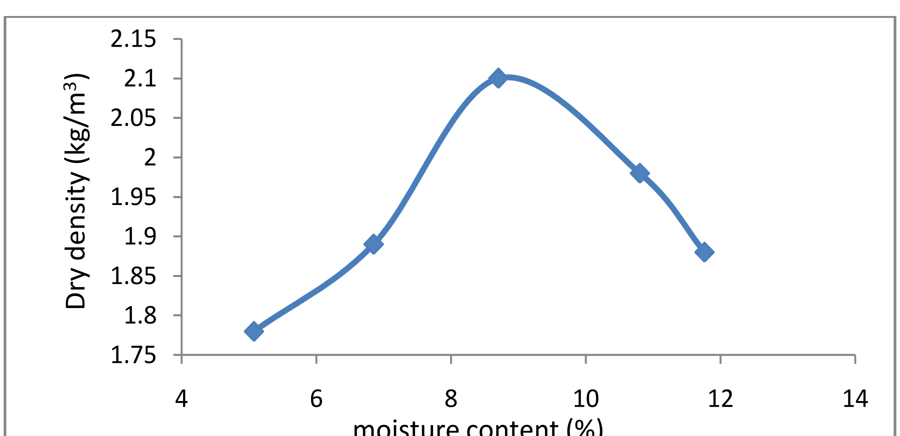

Figure1: Pit No. 27: BS Heavy (BSH) method of compaction

ISSN: 2278-0181
Vol. 2 Issue 8, August - 2013

CONCLUSION

The results of the investigation revealed that the soils have good characteristic index properties due to the degree of expansion, danger of severity are low and non-critical respectively. Most of the soils have good characteristic strength properties due to high values of UCS obtained. The soils will not be suitable for road construction in their natural state as base or sub base material, due to low values of CBR obtained, which were not up to the minimum standard specified by Nigerian General Specifications for Roads and Bridge works. However they can be used as sub grade materials.

RECOMMENDATIONS

The following recommendations were made:

1. The soils need to be stabilized and / modified using cement or lime in line with Ola's findings of A - 2 – 4 to A – 2 -6, 2- 3% maximum for soils improvementof their strength as base or sub base materials.
2. Based on the research carried out, the soils are inorganic and non-acidic, so the use of Portland cement is recommended for more economical building.

REFERENCE

Alexander, L.T. and Candy (1962), "Genesis and Hardening of Laterite in Soils" Tech. Bull 1281, US Dept. of Agric., Washington D.C

BS 1377: 1990: Methods of Test for Soils for Civil Engineering Purposes. British Standards Institution, London.

Lees, G., Abd-el-Kader, M. O. and Hamdani, S. K. (1982). "Sodium Chloride as an Additive in Lime-Soil Stabilization", Highway Engineer, No. 12, Vol. 29, pp. 2-8.

NBRRI (1986), Annual Report of Nigeria Building and Road Research Institute to the Federal Ministry of Science and Technology.

Nigerian General Specifications for Roads and Bridge works (1997), Vol. II Federal Ministry of Works and Housing.

Ola S.A. (1997), "Geotechnical Properties and Behavior of some Nigerian Laterite Soils", Balkema publishes Lagos

Singh, A.(2002), "Soil Engineering in Theory and Practice" , Vol 1 fourth edition-Fundamentals and General Principles Santish kumar Jain for CBS Publisher&Distributor, New Delhi, India.