INFLUENCE OF PARENT MATERIALS ON COMPOSITION AND QUALITY OF PLINTHITE AS A RAW MATERIAL FOR THE BUILDING AND CONSTRUCTION INDUSTRY

BY

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NIGERIA

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NIGERIA

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DECLARATION

I declare that the work in this thesis entitled "Influence of Parent Materials on Composition and Quality of Plinthite as a raw material for the building and construction industry has been carried out by me in the Department of Soil Science, Ahmadu Bello University Zaria. The information derived from the literature has been duly acknowledge in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other institution.

Stephen Garba ZARAFI

Name of Student	Signature	Date

CERTIFICATION

This thesis entitled: "**INFLUENCE OF PARENT MATERIALS ON COMPOSITION AND QUALITY OF PLINTHITE AS A RAW MATERIAL FOR THE BUILDING AND CONSTRUCTION INDUSTRY**" by Stephen Garba Zarafi meeting the regulations governing the award of the degree of DOCTOR OF PHILOSOPHY of Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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Signature Date

DEDICATION

This thesis is dedicated to my Grand Father, Pastor Samaila Yarima Inusa Wushishi and to my parents Mr. and Mrs. Garba C. Zarafi who are his role models.

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I appreciate God for strength and wisdom in carrying out this work successfully. I express gracefully to Prof. Bashiru Ademola Raji, who enabled me accomplish the program through his continuous encouragement.

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ABSTRACT

Pedogenic properties of plinthic (laterite) soils developed on two parent materials; basement complex and basaltic rock in Northern Guinea Savannah, Nigeria were studied with a view to determine the influence of composition and quantity of the soil (plinthite) as a raw material for the construction industry. Four pedons were dug on each parent material. Soil morphological, physico-chemical and mineralogical properties were examined and the soils were classified using USDA and WRB systems. Results indicated that soil morphological properties were generally similar, except for variation in depth and structure. The soils were generally deep to very deep. Dark brown colors dominated the soil surface layers, while red and reddish yellow and yellowish red colours dominated the subsurface horizons. Texture of surface soils were sandy loam, the subsurface soils had sandy clay loam in the plinthic layers and were dominated by subangular blocky structure throughout the eight pedons. Sand fraction dominated the soil separates. Particles density ranged between 2.02 Mg/m^3 (Pedon BS2, Btcv1) and 2.76 Mg/m^3 in (BS1, BCcv) at the surface and subsurface horizons of all the profiles. Bulk density values ranged from 1.31 to 1.80 Mg/m^3. Total porosity values ranged from 28 to 49%. Soil reaction of all the profiles indicated extremely acid to moderately acid throughout the soil depth with pH values ranging from 3.8 to 5.8. Cation exchange capacity (CEC-NH4OAc) values were low to high and moderate base saturation dominated the soils. Values of organic carbon were generally low (0.02 – 0.68 cmo1(+) kg^{-1}). Calcium was the dominant exchangeable base in all the profiles. Exchangeable magnesium (Mg) decreased regularly with soil depth while sodium content was irregularly distributed. Exchangeable sodium percent values decreased regularly with depth in the subsurface horizons of all the profiles except BS1 and BS2 which were irregularly distributed with depth. CBD extractable form of iron ranged from 1.27 to 3.79% in all the profiles studied,

while oxalated extractable obtained 0.33 to 1.61% and pyrophosphate extractable recorded range 0.09 to 1.61% in all the soils. Active iron ratio ranged from 0.06 to 0.95 while clay/dithionite obtained ranged from 7.47 to 89.82 in all the profiles. Aluminum oxide (CBD) ranged from 0.01 to 0.10% with active ratio of ranged 0.01 to 0.17. Manganese oxide (CBD) ranged 0.01 to 0.10% with active ratio range 0.01 to 1.73. Total elemental oxides of silicon, aluminum and iron values dominated all the soils; silicon being most dominated, followed by Fe_2O_3 and Al_2O_3. Geotechnical properties and compressive strength of the soils revealed that soils developed on the basement complex parent material had the highest strength (1.87 Nmm^2) in pedon OL while the lowest strength of materials (0.53Nmm^2) in pedon BS2 in the Basaltic soils. The soils generally fell into two classes in both systems (AASHTO and USCS) used for the engineering classification. Using AASHTO, the Basement complex soils SC and OL were observed to fall into A-2-7 (O) group which was rated excellent to good, while OGR and YL were grouped as A-6(4) and A-7-6(7) in which were rated as fair to poor. However, all the Basalts also fell within A2 at group level, that is, A-2-6(0), A-2-7(1), A-2-7(0) and A-2-7(0) for BS1, BS2, BS3 and BS4 respectively and were rated excellent to good. For the USCS system, the soils were classified as SC, SC, SC, SC, SM, SC, SC, SC and SM respectively. All the pedons were classified as Alfisols except for BS1 as Ultisols using USDA soil taxonomy and plinthic Luvisols (WRB).

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