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ELEMENTS OF SOIL MATERIAL AND ITS FORMATION RELATIVE TO SOIL COMPOSITION IN NIGERIA

ENGR. DR. ARTHUR. C. OSUORAH

Department Of Civil Engineering, University of Nigeria Nsukka, Enugu State, Nigeria

Abstract: The purpose of this study is for the development of knowledge on soil particles as the process of its formation in becoming solid material with the understanding of its natural formation with the environmental nature effects towards the formation of the soil element along with their compositions. The study of this topic leads to the research of environmental materials of soil that relates to formation of soil; Materials like the silicate and kaolinite framework, an overview of the formation of soil, like building block of clay minerals, the type of bonding, common clay mineral of two and three sheets for every layers and Relationship between the engineering properties of Index.

From this study of soil formations, my result will lead to the continuity of the second phase which will be the topic of Index Properties.

Keywords: Formation of Soil, Mineral Relativity

1.0 INTRODUCTION

For this topic of Nature of Soil, its depicting value and the manner in which soil always come into existence, hence by phase relation. This relates to the fact for us to believe in general soil behavior is always very plastic and elastic form, which in turn defines it in general sense of engineering which can be said to be as the un-cemented aggregate of mineral grains and decayed organic matter like solid particles (See Brase M, Das. Pg 1).

However, in a more localized but settled area like Umuchu in Aguata Local Government in Anambra State of Nigeria, the soil deposits are mainly by nature formed by different particles or mineral deposits which relate to phase relation as in pg. 1 of these articles. Some other minerals like clay minerals (pg. 6) are complex aluminum silicates that are composed of one of two basic units. Other minerals in overview of composition of soil in (pg. 3) express Kaolinite which consists of repeating layers upon layers of elements of Silica – gibbsite. (See pg. 3 and 4).

The clay mineral not only related to Aluminum Silicate but also with an extension to Montmorillonite which has similar structure as kalonillite, which is one Gibbsite. (See page 11 of Brager and Daze.). the definition of soil Specific Gravity on pg. 2a of this article did explain an in site of the weight and volume of a composite soil and this relates to two basic soil types of particle distributions of sand and silt. In relation, it is common to express the soil composition and Engineering properties.

2.0 METHODOLOGY

2.1 Phase Relations & Definitions (L & W Chap.3)

- Know definitions of water content (w), void ratio (e), porosity (n), specific gravity ($G = G_s$) & unit weights = total (Y_t), dry (Y_d) & busy art (y_b)
- Remember that $Gw = Se$ (for pore fluid = pure water), S = degree of saturation
- If so for soil mechanics, see Lamba (2005) Soil Testing for Engineers.

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1.2 Two Basic Soil Types

1) Particle size Distribution (Mit classification)

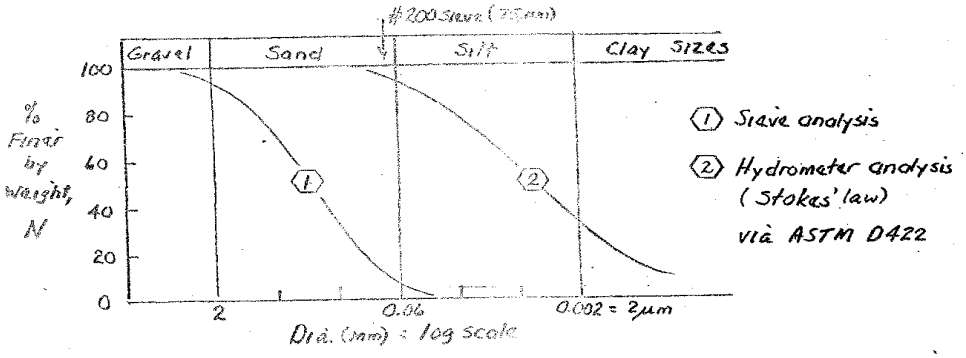

Fig. 2.1. Phase Relationship; Weight of fine vs. log scale.

Table 2.1; General Characteristics on capillary pressure.

K = Coef. Of } Hydraulic Conductivity

No	Type	Particles & Features	Permeability	Practical Implications
(1)	Granular (Cohesionless)	. Large equidimensional . Large Voids }	HIGH	. Max U_c very low . Engr. Properties from in situ penetration test
		. Very low SSA }	HIGH	
		. Only mass forces		. Drained loading
(2)	Cohesive (Clay minerals)	. Small platy shaped . Very small voids }	VERY LOW	. Max U_c very high . Engr. Properties from in situ + lab testing
		. High SSA > $10m^2/g$ }	VERY LOW	. Undrained loading
		. also surface power		

SSA = Specific Surface Area (m^2/g); $U_c = U_a = U_w$ = capillary pressure (Soil Suction)

This is to further demonstrate on this topic, see the following illustrations on fig. 2.2

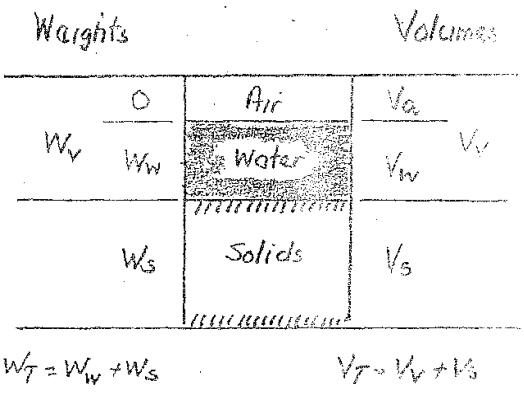

Fig. 2.2a; Unit weight definition

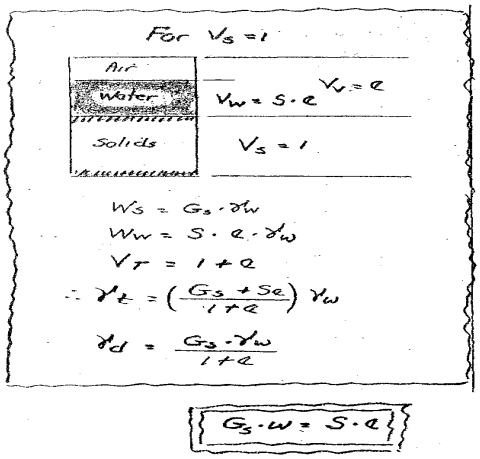

Fig. 2.2b. Specific Weight

Fig II-I Phase relations (for water as pore liquid)

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Definitions
Specific gravity, $G_s = Y_s/Y_w$
Void ratio, $e = V_s/V_s = G_s.W/S$
Porosity, $n = V_v/V_T$
Specific volume, $v = V_T/V_S = 1+ e$
Water content, $W = W_w/W_s = S.e/G_s$
Degree of saturation, $S = V_w/V_v = G_s.W /e$

Unit Weights
Water, $Y_w = 9.81$ KN/m^3 = 6.2 e pcf = 1.00 TCM
Solids, $Y_s = G_s.Y_w$
Total, $Y_t = W_t/V_t = (G_s + S.e / 1 + e) Y_w$
Dry, $Y_d = W_s/V_t = G_s.Y_w/1+ e$
Buoyant, $Y_b = Y_t – Y_w$; for S = 100%, $Y_b = (G_s – 1/1+ e) Y_w$

3.0 COMPOSITION OF SOIL MATERIAL

Using chemical elements that exist in soil composition for analysis and overview for the main group of carbonate oxides, Hydrous oxides; Phosphates and silicates.

3.1 Overview

1) Differences in particle size & shape are mainly due to differences in the types & arrangements of elements in the crystalline structure = MINERALOGY (regular structural arrangement of atomic elements ~ x-ray diffraction pattern).

2) **Five main groups**

- Carbonates: calcite & dolomite used to make cement
- Oxides
- Hydrous Oxide: gibbsite brucite minus OH's ~ shuts in clay minerals
- Phosphates: manuring for fertilizers
- Silicates: > 90% of all soil

3.2 Silicates

1) Silica tetrahedron V = valance O = oxygen(V = -2)
Si = silicon (V = +4

Plan Expended side view

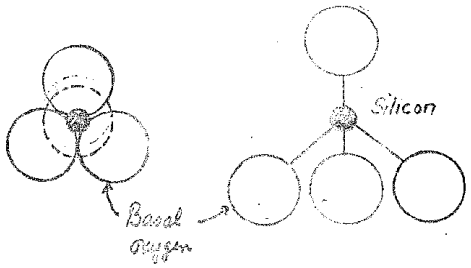

Fig. 3.1(a) Fig. 3.1(b)

Fig. 3.1 Primary valence bonding (covalent + ionic)

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2) How this silica tetrahedral are arranged via the number of shared oxygen's ~ different silicate minerals.

Table 3.1. Showing Class of Silicate Form.

Element	0	Si	Al	Fe	Mg	Ca	Na	K			
Glasstone (2015)	Valence			-2	+4	+3	+2	+2	+2	+1	+1
	Iodine Diai (A^o)			2.8	0.8	1.0	1.5	1.3	2.0	1.9	2.6^5

$1A^o = 10^{-8}cm = 10^{-4}um$

3.3 Silicate Frame works & Composition of Granular Soils

Tetrahedral form 3-D avary so that All oxygen are shaud ~ one Si per two oxygen. Very Resistant to weathering ~ large particles

1) . Quartz $S_i O_2 \times 4 = S_{i4} O_8$
2) . K Feldspar $K\ Al\ S_{i3}\ O_8$
3) . Plagioclase

Relative abundance in sand & silt particles. See Sheet A for other "granular "minerals, e.g Cateite = (4), Dolomite = (5) Muscovite = (6)

Definition of the mineral rocks are as follows; 1. Dolomite is a mineral rock material made of carbonate that contains high percentage substance of $CaMg(CO_3)_2$. 2. Muscovite is just as dolomite. It's a mineral of aluminum and potassium with the form $KAl_2(F, OH)_2$.

3.4 Building Blocks of Clay Minerals

1) All based oxygen of value tetrahedral sheet

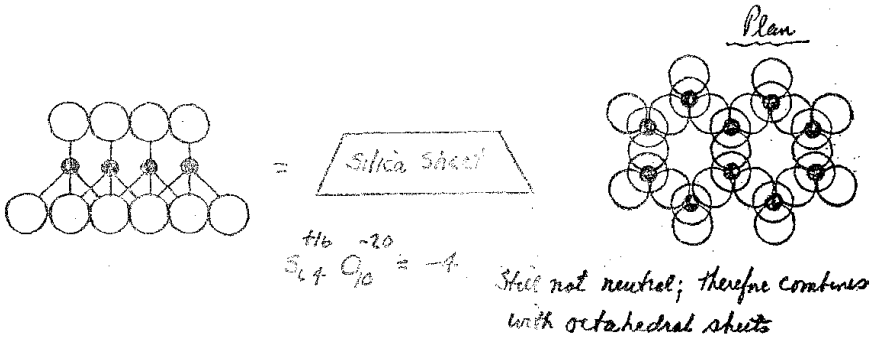

Fig. 2.2

2) Hydrous oxide octahedral sheets .

G = Gibbsite: $6\ OH^{-1}$, $4\ Al^{+3}$, $6\ OH^{-1}$ — $Al_4\ (OH)_{12}$ minus some OH'S

B = Brucite: $6\ OH$, $6\ Mg^{+2}$, $6\ OH$ — $Mg_6\ (OH)_{12}$ " " "

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4 Which sides & hydrous oxide sheets are confined (via primary valence bonding) to form a LAYER and how these layers are "glued" together to form particles ~ different clay minerals

2.5 Types of Bonds Silicates (1 mol = 6.023 x 10^{23} molecules = Avogadro's number)

1) Primary valence (covalent, ionic & metallic) = very strong (15-100 kcal/mol)
2) Hydrogen bonding = intermediate (= 4-5 kcal/mol for water)

H^{+1} Fluctuate between two O^{-2}

3) Vender Waals = universal attractive force ($\leq 1/10^{th}$ of H-bonds)

{Water = H_2O; Dia = $3A^o$; Dipole $(O)^{H}{}_{H}105^0$ ~ (-+)}

CONCLUSION

In conclusion, the composition of soil during formation is the main point of this study, and the relativity among the grain material and the mineral material like silicate with its typical bonding and the primary conditions of hydrogen containing the same covalent, ionic and metallic give us a strong chemical bond.

Refer to Braja et.al (2009); on the INDEX PROPERTIES for group soil with similar Engineering properties, with the objective of relating simple test of two determinants of the soil Type and relative state on Braja, (2015) in which case the relative state, extended into the expression and definition leading to the UNIFIED SOIL CLASSIFICATION (USCS) of (ASTM D2487). of practical book on Geotechnical (Arthur O.; 2012)

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