ANALYSIS OF CHEMICAL COMPOSITION OF MUD-BRICKS IN GWOZA LOCAL GOVERNMENT AREA OF BORNO STATE

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Abstract

Chemical Analysis of Mud-Bricks samples from specific locations in Gwoza District Borno State for their cementing quality was carried out. Mud-Bricks sample were selected using Latin-square sampling techniques and asking method was used in the sample preparation for the analysis. It was found that the Mud-Bricks obtained from Gwoza District were lacking in lime, an important ingredient responsible for cementing properties. It is therefore suggested that addition of lime to Mud-Bricks in these areas could make significant improvement in the cementing properties and hence improve the Mud-Bricks quality.

Introduction

The high cost of both imported and locally manufactured cement calls for the development of alternatives. Though Mud-Bricks have been used in Nigeria for centuries, their suitability as substitute for cement has not been chemically evaluated in Gwoza District.

This paper embodies the result of the investigation conducted on the Mud-Bricks samples obtained from Gwoza and its environs to ascertain their chemical constituents and hence allow proper evaluation of their cementing properties.

Mud-Bricks Samples

The Mud-Bricks were made by intimately mixing soil, hay and water to produce a workable material which is then moulded into "Mud-balls" or Mud-bricks. The Mud-bricks are sun-dried and used for building. A freshly prepared working mix utilized as a cementing material between the bricks.

Experiment Soil

Sample

The Soil Samples were obtained from five different locations in Gwoza District, Borno Stale namely: Gwoza town, Limankara, Hambagda, Pulka and Ngoshe respectively.

Preparation of Stock Solution

Stock Solution of Ti, Al, Fe, Ca, Mg, Na, K and Li was prepared from the nitrate salts of these metals by dissolving them in distilled water and making up each volume with 5ml of concentrated HNO_3 to give a 1000 P.P.M solution. The standard working solutions were prepared accordingly from the stock solutions.

Apparatus Used

A Unicam SP 1900 atomic absorption spectrophotometer with the various metal hollow cathode lamps were used with an air/acetylene flame.

A Pye Unicam SP 6200 corning - Ed flame photometer with lithium, sodium and potassium filters were employed.

A Colorimeter

Analysis of Mud-Bricks Samples

(i) Loss on Ignition

1,000g of the finely, ground and dried (105-110C°) Mud-bricks sample was weighed in a clean constant weight platinum crucible. The latter was partially covered with the lid and placed in muffle furnace. The temperature of the muffle furnace was slowly raised to 1000 + 20°C and the sample ignited at this temperature for 30 minutes. The crucible was then removed from the furnace, completely covered with the lid, cooled in the desiccators and weighed. The loss of weight recorded for each sample is shown in Table 1.

(ii) **Determination of** Silica

The method used in this investigation was the gravimetric technique utilizing the coagulation procedure as recommended by Bennett and Reed (1971) and modified by increasing the time of sample digestion prior to the addition of hydrochloric acid. The residual or soluble silica left in the solution after the preparation of the main silica was determined calorimetrically using molybdenum blue indicator. The total silica content was obtained by adding the determined values from main silica and residual silica together. The result are given in Table 1.

(iii) Determination of Metal **Oxides**

(a) Decomposition of Mud-bricks Samples:

The method used for the decomposition of the Mud-Bricks sample was the alkaline fusion followed by the dissolution of the cake with concentrated Hci or H_2SO4- the resulting solution was used for the determination of $AI_2O.i$, TiO_2, Fe_2O_3, CaO and MgO.

However, for the determination of Na_2O and K_3O, the modified acid decomposition method was used (Egila and Sigh, 1985).

(b) **Aluminum Oxide, Al_2O_3**

Aluminum was separated from other metals by first precipitating it together with some of the metals in the form of their hydroxide and then separating from other metals by extracting the latter as cupferrates in chloroform. The Aluminum content was then determined titrimetrically with EDTA (Tikhonov, 1973).

(c) Titanium Oxide, TiO_2

Titanium was determined by a colorimetric method (Allport and Brocksupp, 1963). This method is based on the formation of a yellow colour when titanium sulphate is oxidized with hydrogen in acid medium (IM M_2SO_4).

(d) Manganese **Dioxide, MnO_2**

Manganese was determined by colorimetric method, (Williard and Greathouse, 1917). The method is based on the oxidation of $Mn^{2,}$ to Mn^{4f} by potassium or sodium rnetaperiodate in a strongly acidic solution.

(e) Iron **(HI) Oxide, Fe_2O_3, Calcium Oxide, CaO and Magnesium Oxide, MgO**

Atomic absorption spectre-photometry, (Prince, 1972) was used for the determination of fe, Ca and Mg in the sample solution.

(f) Lithium Oxide, LiO_2, Sodium Oxide, Na_2O **and Potassium Oxide, K_2O**

Lihium, Sodium and Potassium were determined in the Mud-bricks samples by flame photometry (Mavrodineau and Briteux, 1965).

Results And Discussion

The results of the analysis of the Mud-brick samples are shown in the below table.

Table 1: Composition of Mud Brick (% By Weight)

Sample	Loi	SiO}	A I A	..A.	Ms°	CaO	Li_2O	Na:O '!	K:O	T;O:	MnO_2	P_20_5
Gwoza	4.02 +0.05	81.90 +0.97	10.05 +0.14	1.63 +0.13	0.10 +0.02	0.0 0.0	0.12 +0.02	0.03 -• :-.	021 :	~: 0.04 L- K».12 |	+0.01	0.68 +0.06
Limankara	3.87 +0.13	80.43 +0.64	8,24 +0.21	2.00 +0.11	0.24 +0.06	0.0 0.0	0.46 +0.04	0.68 +0.07	2.S4 +0.09	0.63 :	' 06 moi	0.32 [_+0.02
Hambagda	4.72 +0.18	83.32 u±0.9J	7.16 +0.12	3.15 u+2ii	0.15 +0.02	0.0 uAL.	0.11 +0.01	0.35 +0.07	0.38 ^0.04	:•	0.02 +0.01	0.21 +0.03
Pulka	5.92 +0.12	78.32 +0.76	7.64 +0.23	4.60 +0.17	0.26 +0.5	0.0 0.0	0.44 +0.08	0.03 +0.02	: " +0.02	0.25 +0.03	0.03 +0.01	0.42 +0.04
Ngoshe	4.75 +0.19	82.42 +0.84	7.06 +0.21	2.41 +0.18	0.14 +0.03	0.0 0.0	0.13 +0.02	0.27 +0.04	0.36 +0.03	. 1" +0.03	0.03 +0.03	0.22 +0.02

LOI = Loss on Ignition

Three Determinations Were Carried Out On Each Sample

From the data, silica. SiO_2, appears to be the predominant component of the Mud-bricks. The value obtained ranged from 78.32% to 83.32%. The high value of silica may be due to the fact that the soil used for making the Mud-bricks is usually the loamy soil which consists mostly of sand. The alumina, A!$_2$O$_3$,, values ranged from 7.06 to 10.05% whereas the amount of iron oxide is fairly high, 1,63 to 4.60% and may be responsible for the reddish/brown colour of some of the Mud-bricks samples obtained from Limankara and Hambagda areas. The fairly high concentration of alkali oxides in the Limankara Mud-bricks (0.68 and 2.84%) may be due to the mixing of the soil with hay, ashes and animal droppings during the preparation process.

The lime content of the Mud-brick sample was found to be zero. This may be ascribed to the existence of calcium in soils as $CaCO_3$ and $CaSO_4$ which can be washed away easily by rain water, (Russel, 1957). Other oxides, MgO, TiO_2, P_2O_5, and MnO_2 occur in relatively low concentration (less than 1%) in all the samples.

Conclusion

The lack of cementing qualities in Mud-bricks and the consequent inability of the Mud-bricks to withstand adverse conditions such as rain, stress, strain etc, is due to lack of lime in the soil in these areas. It is therefore suggested that Mud-bricks, when used, should be supplemented with additional lime.

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