International Journal on Applications in Civil and Enviornmental Engineering
Volume 1: Issue 1: January 2015, pp 6-8. www.aetsjournal.com

The Use of Lime Sludge and cement for the Production of Green Brick

Nafsal khaleel, T Ramasamy

Abstract— This project is designed for making bricks using laterite soil mixed with cement and lime sludge. We adopted the name"Green brick" because the materials used for making the brick is from nature except cement. In many countries, the need for locally manufactured building materials can hardly be overemphasized because there is an imbalance between the demands for housing and expensive conventional building materials coupled with the depletion of traditional building materials. To address this situation, attention has been focused on low-cost alternative building materials. In this study, the quantity of cement used for making green brick is less, Lime sludge and laterite soils are two important materials used for making green bricks. Due to this reason, cost for making the green brick is less. This is a research paper because the introduction of Lime sludge in brick making is a new idea.

Keywords— Lime Sludge

I. INTRODUCTION

In olden days, soils with some percentage of silt and clay were used for building non-load bearing walls. Formation of cracks within a short time due to lack of binding materials (such as cement) and considerable amount of shrinkage, they are not being used these days. We can see such soil made walls in ancient cities in our country. Due to demands for housing, depletion of traditional building materials and expensive conventional building materials, the need for locally manufactured building materials can hardly be overemphasized.

This project is designed for making bricks using laterite soil mixed with cement and lime sludge. We adopted the name" Green brick" because the materials used for making the brick is from nature except cement. In many countries, the need for locally manufactured building materials can hardly be overemphasized because there is an imbalance between the demands for housing and expensive conventional building materials coupled with the depletion of traditional building materials. To address this situation, attention has been focused on low-cost alternative building materials. In this study, the quantity of cement used for making green brick is less, lime sludge and laterite soils are two important materials used for making green bricks. Due to this reason, cost for making the green brick is less. This is a research paper because the introduction of lime sludge in brick making is a new idea Lateritic soils are widely used as fill material for various construction works in most tropical countries. These soils are weathered under conditions of high temperatures and humidity with well-defined alternating wet and dry seasons resulting in poor engineering properties such as high plasticity, poor workability, low strength, high permeability, tendency to retain moisture and high natural moisture content. The effective use of these soils is therefore often hindered by difficulty in handling particularly under moist and wet conditions typical of tropical regions and can only be utilized after modification/ stabilization. Lateritic soils that present such problems during construction processes are termed problematic laterites. Nearly all types of laterites soils are rusty-red due to the presence of iron oxide. Laterites soil consists of high clay content. This clay content ensures a strong and durable brick and it must have specific properties that confer a high degree of plasticity when mixed with water, so that it can be moulded into a brick.

Nafsal Khaleel, Student, Mahendra Engineering College, Namakkal, (nafsalk18@gmail.com, Phone No: 9961920550)

T. Ramasamy, Assistant Professor Mahendra Engineering College, Namakkal

II. PROPERTIES OF MATERIALS

A. Lime Sludg

Sludge used in this study is collected from Hindustan private limited, Kottayam producing about 4-5 ton of sludge daily.

Lime sludge is a very fine precipitated CaC03 particles along with unsettled dregs carried over from green liquor clarifier. Major impurities associated with lime mud (sludge) are Silica and Magnesium. Silica enters mainly via raw materials or through purchased lime and goes to chemical recovery loop. During the caustic zing operation Si02 forms Ca Si03 which is geletinous in nature. This geletinous nature hinders the setting property of lime mud (sludge). It has been observed that high percentage of silica in lime mud entraps higher moisture content.

Sl No.	Sludge Source	Physical State	Moisture Content (%)
1	Paper Sludge	Cake	40-50
2	Phospho Chalk	Cake/Slurry	20-65
3	Carbide Sludge	Slurry	60-80
4	Sugar Sludge	Cake	40-50
5	Chromium Sludge	Cake	35-45
6	Soda Ash Sludge	Slurry	80-90

B. Chemical Properties of Lime Sludge

Sl No.	Constituent	Present in Lime Sludge (%)
1.	SiO2	2-8
2.	Al2O3	0.8-1.2
3.	Fe2O3	0.8-1.2
4.	CaO	48-53
5.	MgO	0.2-3.0
6.	SO3	0.1-0.3
7.	Na2O	0.8-2.0

C. Cement: (OPC)

Sl No.	Parameter	Limits is: 456(12)
1	Ph	6.5 -8.5
2	Chloride	2000mg/l(pcc) 500mg/ l(rcc)
3	Alkalinity	<25ml
4	Sulphate	400mg/l
5	Fluorides	1.5 mg/l
6	Organic Solids	200mg/l
7	Inorganic Solids	3000mg/l

D. Water

Water is an important ingredient of brick as it actually participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water is required to be looked into very carefully.

III. EXPERIMENTAL PROCEDURES

Manual operated block making machine was used to produce 305 x 143 x 100mm Green bricks. The blocks are stacked and then cured by spraying water for 28days, and thereafter, allowed to dry in the laboratory for 30days before tests were carried out on them.

Laterite Soil and Reconstituted Soil.

Locally available reddish brown laterite obtained from Elelenwo area of Port Harcourt (fig. 2) Was used for the block production. Its clay fraction was 18%; while the liquid limit, plastic limit and plasticity index of the soil was 38.5%, 19.8% and 28.7% respectively. As the clay content was more than 10%, it became necessary to reconstitute the clay by adding natural bed sand (specific gravity of 2.65and clay fraction of 5%) to it, in order to bring down the clay fraction of the mix (mix ratio of soil to sand was 1.2 by weight). The resulting mix contained 8% clay, 16% silt and 69% sand as shown in the grain size distribution of the late rite sand and the reconstituted soil - sand mixture

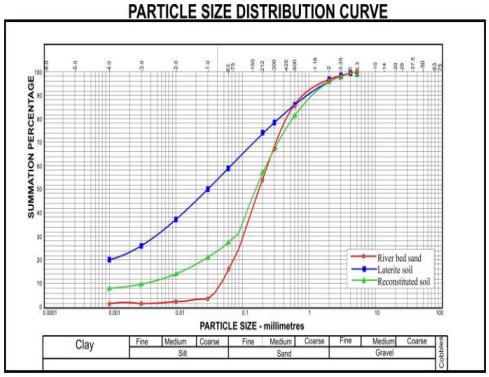

FIGURE 3: PARTICLE SIZE DISTRIBUTION FOR SAND,

IV. CEMENT TESTING AND CHARACTERIZATION

In the test result shows according to Indian standard classification system, cement has 2.96667% of Fineness. The particular cement has Percentage of water for standard consistency of 29. The particular cement has Initial setting time of 200 min and Final setting time of 4 h 10 min. And the particular cement has Compressive strength of cement at 3 days, 7 days and 28th day's has16.22 N/mm2, 19.86 N/mm2 and 30.85 N/mm2. As the cement properties were in good correlation with the IS Specifications.

V. MIX DESIGN

The adopted mix ratio for the manufacturing of soil block is 1:7 for the all mixes. Totally 2 types of mix is proposed
Totally 2 types of mix is proposed they are:

a. Mix 1-Cement: Laterite Soil and Sand
b. Mix 2-Cement: Laterit Soil, Sand and Lime Sludge

Both the mixes were observed, compared and the interpretation of results based on their compressive strength.

VI. MANUFACTURING AND EXPERIMENTAL PROGRAM

The following equipment has been used to manufacture the soil blocks they are, Brick mould, Trowel, Batching container, Mixing machine, Table vibrator, Trolley, Oil, Weighing machine, curing tank and Oven.

Casting Procedure

The materials required for making the mix are taken and are weighed. After the weighed materials are placed inside the mixing machine and are mixed. Then the materials are uniformly mixed, water is then added to the mix. After the mix is placed inside the batching container and the Oil is applied on the sides of the brick mould and the mix is applied in 3 layers to the mould. After Vibrations are provided to each layer with the help of vibratory machine and the surface is finally leveled. After remolding is carried out on the next day and the brick is weighed. For drying the brick is kept

under atmospheric conditions for one day and brick is weighed after this. The brick is kept in the curing tank.

After 7 days, compressive strength test need to be carried out. After 28 days, compressive strength test need to be carried out. The Block density and Water absorption test is carried out after 28th day. And the brick is firstly weighed and kept for oven drying at 100oC. After 24 h, it is weighed and water absorption test is thus done. Stabilized Soil

Bricks of size 330 × 150 × 150mm were prepared for the compressive strength testing. Laterites mixed with 45% sand were used in the production of laterite bricks. The following observations were made in compression tests at 7 and 28 days.

VII. TEST ON LATERITE BRICKS

COMPRESSION STRENGTH TEST

Lime sludge content (%)	0	1.5	3	4.5
0% Cement Content at 7 days				
Weight of Bricks (kg)	11.54	11.62	11.81	11.90
Density of Bricks (kg/m3)	1535.35	1564.9	1590.5	1602.7
Load at Failure (kN)	12.4	14.2	29.4	50.8
Compressive Strength (N/mm²)	0.25	0.29	0.59	1.03
4% Cement Content at 7 days				
Weight of Bricks (kg)	11.33	12.4	12.46	12.53
Density of Bricks (kg/m3)	1524.9	1670.1	1678.1	1687.5
Load at Failure (kN)	10.0	17.80	30.8	104
Compressive Strength (N/mm²)	0.20	0.26	0.62	2.10
Lime sludge content (%)	0	1.5	3	4.5
0% Cement Content at 28 days				
Weight of Bricks (kg)	11.40	11.44	11.56	11.7
Density of Bricks (kg/m3)	1535.35	1540.7	1556.9	1575.75
Load at Failure (kN)	12.4	35.0	63.0	82.0
Compressive Strength (N/mm²)	0.25	0.70	1.27	1.66
4% Cement Content at 28 days				
Weight of Bricks (kg)	11.21	12.2	12.3	12.48
Density of Bricks (kg/m3)	1509.78	1643.0	1656.56	1680.8
Load at Failure (kN)	10.0	41.0	105.0	164.0
Compressive Strength (N/mm²)	0.20	0.83	2.12	3.31

Table.1.Summary of 7 days and 28 days Average Compressive Strength Test of Bricks

Using the optimum cement content of 4% and a Lime sludge content of 3% 28 day compressive strength of 2.12 N/mm^2 for bricks as the criteria, compressive strength test results show that soil-cement mixtures did not satisfy both requirements. The requirement was met at 9% cement, which is far above the economic cement content. For a laterite-cement mixture of 45% sand and 4% cement and 3% of Lime sludge a compressive strength of 2.12 N/mm^2 was obtained. This value met the requirements Studies shows if higher-pressure ranges were used in moulding the bricks, the expected compressive strength results would be higher than the values obtained here.

VIII. CONCLUSION

- Particle size distribution curve of the laterite used in this study was poorly graded and addition of 45% sand corrected this deficiency.
- Addition of 45% sand content by dry weight of laterite enhanced its suitability for use in the production of bricks within the optimum cement content of 4% and Lime sludge content of 3%.
- In Kerala have plenty of laterite soil sources, the production and use of laterite bricks will be economical.
- The Lime sludge is from papper mill waste with no cost.
- The optimum cement content of 4% cement and 3% of Lime sludge content keeps the laterite bricks in the economical limit.
- Green bricks can be used for low cost construction.

REFERENCES

[1] *"Use of Cement-Sand Admixture in Laterite Brick Production for Low Cost Housing"*- Isaac Olufemi Agbede and Manasseh Joel © Leonardo Electronic Journal of Practices and Technologies, Issue 12, January-June 2008.

[2] "*Performance of Laterite-Cement Blocks as Walling Units in Relation to Sandcrete Blocks*"-James Isiwu AGUWA© Leonardo Electronic Journal of Practices and Technologies, Issue 16, January-June 2010.

[3] "*Study of Compressive Strengths of Laterite-Cement Mixes as a Building Materia*"- James Isiwu Aguwa © AU J.T. 13(2) 114-120 (Oct. 2009).

[4] The Use of Fly Ash and Lime Sludge as Partial Replacement of Cement in Mortar Vaishali Sahu *, V. Gayathri