EXPERIMENTAL STUDY ON MANUFACTURING OF BRICKS USING WASTE MAGNESITE SOIL

A.Padmanaban [1], A.Karthik [2], N.Sathish[3]
Assistant professor
Ganadhipathy tulsi's jain engineering college, vellore.

Abstract

Traditionally fertile soil is used as a primary raw material to make bricks. Due to the higher demands for bricks in construction industries there is a need of huge amount of red soil. In order to reduce the usage of fertile soil an alternative material is required. In our project the waste Magnesite soil from TamilNadu Magnesite Corporation (TANMAG) located at Salem is used as the alternative material to make the bricks were fertile soil is replaced by various percentage of Magnesite soil. Magnesite soil with admixtures (bentonite powder) of various percentages to check the compressive strength and water absorption. That percentage ratio is 5%, 10%, 15%, 20%, 25% and 30%.Then manufacturing of bricks in two methods. First method is magnesite soil and red soil mixed with preparing bricks. Second method is magnesite soil and admixture mixed with preparing of bricks. Next furnace of bricks in factory. Next testing of bricks and compare with two type of bricks. Tested in water absorption, compressive strength of bricks and tensile strength of bricks. The tested on bricks as per 1077:1992, 2180:1988 and 2222:1991 etc., for recommendations. The tested on comparison of compressive strength for two type of bricks samples.

Keywords – Magnesite soil, Red soil, Admixture (Bentonite Powder).

1. Introduction

With growing industrialization and development of the country, the demand of bricks has increased many flood. The major problems facing the bricks industry are to increase the production, stabilisation of prices and to improve the quality the bricks. The quality of brick depends on the quality of raw material and the firing technique. Plasticity of soils impurities associated with the soil and other characters of the soil must be considered.

In India there are there major types of soil deposit which are generally used for the manufacture of brick:

Alluvial soils of indogangetic plains consist of ilitic clay minerals.

Black cotton soils overlaying Madhya Pradesh, part of Maharashtra and Gujarat. Black cotton soil is a mixture of various clay minerals of montmorillonite group.

Red soils occurring in the region of Mysore, Assam, m.p.etc. These soils consist of kaolinite group of minerals.

Out of these three, alluvial soils are only good for manufacture of bricks.

Table 1.1 Earths of the following physical properties are most suitable for bricks manufacture:

Properties	Percent
Clay	20-30
Clay + silt	40-65
Liquid limit	25-38
Plastic index	7-16
Volumetric shrinkage	15-25

In general, alluvial soils containing 17% clay and 30% to 35% silt can be used for the manufacture of building bricks. The calcareous soils containing calcium carbonate preferably up to 1% can be used for manufacturing the bricks. The bricks from these can be fired in a temperature range of 900 to 1060°C or even upto 1120°C. for first class bricks from sandy soils, firing at higher temperature (1060°C to 1120°C) has been recommended. Water absorption of fired bricks decreases with increase in firing temperature. Soil containing higher percentage of calcium carbonate absorbs more water and it is independent of firing temperature. The bulk density of bricks increases with increases in firing temperature. Bricks fired at 1120°C have bulk density in range of 2.0 to 2.32. Bricks from alluvial soils may have compressive strength as high as 60 to 110N/mm^2. Black cotton soils are highly clayey, highly plastic and rice in calcium carbonate content. They also contain sufficient amount of kankar. Being highly plastic in nature, these soils expand in presence of moisture and shrinks considerably during drying. Bricks made of such soils show cracks and hence these soils are not suitable bricks manufacture. Lime bursting is the main problem of bricks manufacture from these soils. These bricks absorb too must water and the compressive strength of such bricks is also very low. Good quality of bricks can be manufacture from these soils only by adding some opening materials like grog, coal ash, salt etc. Red soils being sandy in natural do not make good bricks. These soils conation low percentage of clay and silt. Soils containing more than 40 percent clay and silt can yield good bricks provided they are fired above 1000°C temperatures.

2. Literature

2.1 General

The present investigation deals with studies on the building bricks and so an attempt has been made to review briefly the available literature are Waste utilization in construction industry, Fly ash bricks andPapercrete bricks.

A large number of investigations are available in the literature on the above topics and only those investigations that are related to the strength, durability, ductility and energy absorption capacity on the above topics are discussed here. The scope of the present study is mentioned at the end of the chapter.

2.2 Literature Review

Carter et al[1] dealt with the incorporation of ungrounded rice husks into handmade, kiln–fired bricks. Bricks with a range of rice husk contents were prepared and then fired in either small electric kiln or a commercial Hoffman kiln. The properties like density, compressive strength, modules of rupture, water absorption and initial state of absorption were measured. They concluded from the results that it was possible to incorporate up to 50% rice husks (by volume of clay) into bricks without causing brick properties to fall outside the limits acceptable in developing countries.*Weng Chin-Huang et al*[2] demonstrated suitable conditions for using dried sludge as a clay substitute to produce engineering quality of brick. The proportion of sludge in the mixture and the fixing temperature are the two key factors affecting the quality of brick. After the experimental study, they recommended that the proportion of sludge in brick was 10% with 24% optimum moisture content, prepared in the molded mixtures and fixed between 800 C and 960 C to produce a good quality brick.*Michele et al*[3] outlined the thermal conductivity of clay and physical or micro-structural parameters which affect their thermal behaviour most significantly.A comparison of the correlation between the thermal conductivity data collected from the literature and those obtained in the present work with the bulk density highlighted that the dependence of thermal conductivity on bulk density, quoted by several authors was not always very obvious and was not able to describe accurately the thermal behaviour of clay bricks. Through a statistical treatment of data, some trends regarding the relationships among the thermal conductivity and the main mineralogical and micro-structural variables of bricks were revealed. The simple linear binary correlations and the multivariate analyses (factor analysis and multiple linear regression analysis) highlighted the role played by some mineralogical components, in particular Ca-rich silicates (wollastonite and melilite), quartz and amorphous in depressing the insulating properties of clay bricks. On the other hand, among the microstructural parameters, the role of open porosity in improving the thermal performances of bricks was found to

be predominant. *Tutunlu and AtalayUmitet al*[4] reported the addition of fly ash upto 60% at a firing temperature of 950°C and it did not have any harmful effects on the brick quality. Also they stated that the use of fly ash as a raw material for the production of building bricks was not only a viable alternative to clay but also a solution to a difficult and expensive waste disposal problem.*ObadaKayaliet al*[5] *investigated* the high performance of bricks from flyash. He concluded that the flyash brick had 24 % better compressive strength and 44% higher bond strength than the good quality clay brick. Also, he reported that the tensile strength of the flyash brick was three times greater than the value for standard clay bricks.*Henry Liu et al*[6] probed the environmental properties of Fly ash bricks and reported that the flyash brick passed the Toxicity Characteristic Leaching Procedure (TCLP) test recommended by Environmental Production Agency (EPA) with large margins. Also it can absorb carbon-dioxide from the atmosphere causing carbon sequestration. Consequently, it reduces the CO2 in the atmosphere which helps to mitigate global warming.*Parvizet al*[7] proffered the durability and moisture effects on waste paper – fiber – cement composites. They posited that the increase in the moisture content of virgin and recycled composites reduced the flexural strength and stiffness while it increased the toughness of the composites. The effects of long-term immersion in hot water on the flexural strength, stiffness and toughness of recycled composites were not statistically significant at 95% level of confidence. The flexural stiffness of virgin and recycled composites was affected differently by this ageing process. Also, they reported 30% replacement of cement with silica fume in recycled fiber and that cement composites appeared to be highly effective in controlling the aging mechanisms and moisture effects. This approach presents a practical, economic and efficient way of enhancing the durability and moisture resistance of waste paper – fiber – cement composites.*Ahmadi et al*[8] reported the results of an investigation on the utilization of paper waste sludge obtained from a paper manufacturing industry, as a replacement to the mineral filler material in various concrete mixes. The physical and chemical properties of the waste material were studied. The test results revealed that as the content of the waste increased the water to cement ratio for the mix also increased, since the waste has a high degree of water absorption Therefore, an additional amount of water was required for cement hydration. The results obtained showed that as the amount of the waste increased, the basic strengths, such as compressive strength, decreased. A maximum of 5% content of the waste as a replacement to the fine sand in concrete mix can be used successfully as construction materials, such as in concrete masonry construction with a compressive strength of 8 MPa, splitting strength of 1.3 MPa, and water absorption of 11.9% with a density of 20 kN/m3.*Farrell et al*[9] furnished the results of a preliminary study into the properties of concrete manufactured with various binder blends incorporating Portland Cement (PC), Waster paper Sludge Ash (WSA) and Ground Granulated Blast-furnace Slag (GGBS). The PC was practically replaced with either WSA or a 50:50 blend of WSA: GGBS at replacement levels of 0%, 20%, 40%, 60%, 66% and 80%. The results obtained indicated that it was possible to partially replace PC with WSA or a 50:50 WSA: GGBS blend to produce an effective binder for concrete. The optimum mixture compositions with respect to strength development involve replacement of 40% of PC with either WSA or WSA – GGBS blend. WSA has a significant effect on the water demand and setting times of the mixtures investigated. The use of retarder/plasticizer is essential at replacement levels in excess of 20% WSA and 40% WSA: GGBS to achieve a mix of workability similar to that of the control.*Solberg et al*[10] stated that landfills in most parts of the country were clogged with wastepaper and cardboard. Millions of people lived in substandard housing or have no housing at all. When wastepaper is recycled as papercrete to construct houses for these people and when landfills are removed, these problems can be solved.

3. Materials and Methods

Table 3.1 Material Properties

Type of properties		Red Soil	Magnesite Soil	Bentonite Powder
Physical properties	Color	red color	dull white	white
	Size	0 to 4mm	0 to 6 mm	0 to 5 mm
Chemical properties	Alumina (Al_2O_3)	20 to 30%	00.20 to 1.00%	11.15%
	Silica (SiO_2)	35 to 50%	06.00 to 14.00%	50%
	Silt	20 to 25%	-	-
	Iron oxide, Lime, Magnesia	1 to 02%	-	-
	Loss on Ignition (LOI)	-	42.00 to 48.00%	-
	Ferric Oxide (Fe_2O_3)	-	00.20to 2.00%	-
	Calcium Oxide (CaO)	-	00.20 to 2.00%	-
	Magnesium Oxide (MgO)	-	0.20 to 1.00%	-
	Oxide of iron	-	-	18%

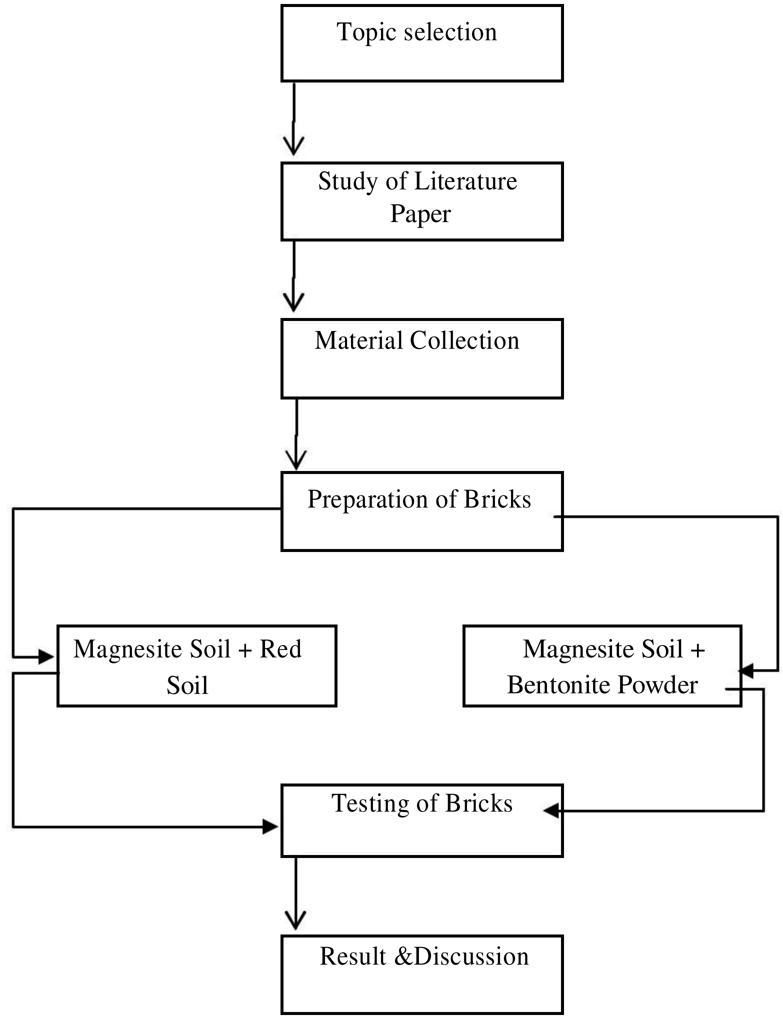

Figure 3.4 Methodology

4. Brick Specimens: Testing For Strength Optimization and Material Percentages

4.1 General

Bricks are used almost all over the world because their constituents' cost is low. They can be manufactured with the help of locally available labour. Brick are used masonry walls provide heat insulation properties to the construction. The engineering designs of masonry structures have evolved largely from the construction practices. The masonry structures that have proven to be safe and serviceable under gravity loads have provided useful information for the modern design criteria. The behaviour of brick under monotonically increasing compressive forces and failure mechanism are explored in this paper. This paper presents the response of test prisms under concentric compressive axial forces. The specimens were fabricated using In order to reduce the usage of fertile soil an alternative material is required. In our project the waste Magnesite soil from TamilNadu Magnesite Corporation (TANMAG) located at Salem is used as the alternative material to make the bricks were fertile soil is replaced by various percentage of Magnesite soil. Magnesite soil with admixtures (Bentonite Powder) of various percentages to check the compressive strength and water absorption. That percentage ratio is 5%, 10%, 15%, 20%, 25% and 30%.

The strain was measured in vertical direction using strain gauges and demec gauges and in lateral direction using demec gauges only. The stress strain curves for the masonry specimens were developed and the secant modulus, compressive strength and Poisson's ratios were calculated. The failure mechanism of the masonry specimens under compression is explained considering the splitting tensile strength of bricks.

4.2 Compressive Strength: Compressive strength = load/area = P/A

Table 4.1 Compare the Results for Compressive Strength [Type I & II]

Percentage	Type I	Type II
0	8.50	8.50
5	9.02	8.70
10	9.23	9.50
15	9.76	9.55
20	8.40	8.03
25	7.20	6.78
30	7.17	6.67

Measure to the brick size and fixed in brick is

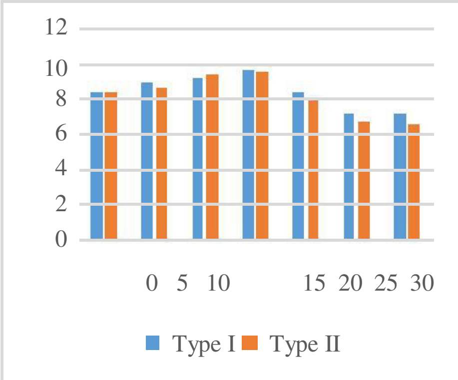

Figure 4.1 Compressive Strength Brick (Type I & Type II)

4.3 Split Tensile Strength:

Split tensile = 2P/πLH

Table 4.2 Compare the Results for Split tensile Strength [Type I & II]

Percentage	Type I	Type II
0	0.39	0.39
5	0.42	0.42
10	0.44	0.45
15	0.48	0.46
20	0.37	0.38
25	0.33	0.37
30	0.30	0.34

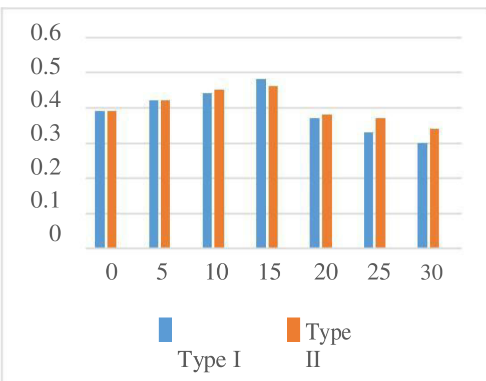

Figure 4.3 Split Tensile Strength Brick (Type I & Type II)

4.4 Water Adsorption Test for Brick:

Water adsorption (%)

$$= [(W_2 - W_1)/W_3] \times 100$$

Table 4.3 Compare the Results for Water Adsorption [Type I & II]

Percentage	Type I	Type II
0	14.88	13.45
5	15.20	13.33
10	13.04	13.29
15	12.25	13.20
20	14.85	13.76
25	14.80	14.55
30	14.58	14.81

compressive testing machine. The position of brick faced into width of brick in our face direction. Take the 50mm plate in 2nos and 8mm mild rod. Next set up into first placed in lower plate and lower rod will be fixed into above the lower plate then placed in brick is above the lower rod. And next upper rod is placed in above the brick then placed upper plate is above upper rod. Finally all are fixed in testing machine. Then gradually load will be applied and note down the failure load of brick **(Figure 4.4).**

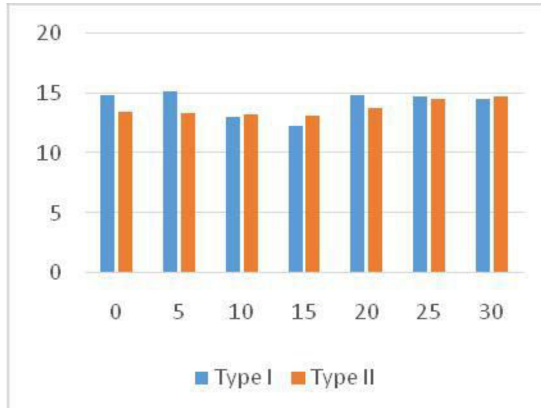

Figure 4.5Water Adsorption of Brick (Type I & Type II)

Measure to the brick size and take of the dry weight of brick. Next placed of bricks in water into 24 hours. Then after 24 hours take in brick and take wet weight of brick. And placed a brick is into an oven in 24 hours. Maintain of 115°C in 24 hours and take a brick check the weight of brick. And finally calculate the percentage water adsorption of brick

5. Conclusions

This project involves testing of two types of bricks and comparing the results of compressive strength, split tensile strength and water adsorption of conventional bricks. Bricks are manufactured by mixing red soil and admixtures in various percentages 0%, 5%, 10%, 15%, 20%, 25% and 30%. Optimum strength values are obtained at 15% replacement of admixtures and above which there is a decrease in strength. The results of type I bricks are found to be good compared to type II bricks. Hence type I bricks are suitable for construction.

Reference

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