EXPERIMENTAL INVESTIGATION OF CLAY BRICK WITH THE PARTIAL REPLACEMENT OF CERAMIC WASTE POWDER

Author S. Deepa priyadharshini[1] D. Dharani[2] M. Prasanya[3]
Department of Civil Engineering
Arjun College of Technology, Coimbatore - 642120

ABSTRACT: Clay bricks are more popular in building construction than the cement or concrete bricks because of their eco-friendly characteristics. Presently in ceramic industry the production goes as waste, which is not undergoing the recycle process yet. About 30% of the daily production in the ceramic industry goes as waste. These bricks were doped with ceramic powder of ratio 5%, 10%, 15%, 20%, 25% of the total weight mixture of the normal bricks. After mixing the ratio of ceramic powder, brick has been moulded in the dimension of 200mm*100mm*100mm. The moulded brick is allowed to dry for 4 days in 28℃ - 31℃ atmospheres and dried brick is fired in traditional method at 1250℃. The physical and mechanical properties were tested in both field and laboratory tests.
***Keywords*: Clay brick, Ceramic powder, Compressive strength, water absorption, Eco-friendly.**

INTRODUCTION

Clay is a finely-grained natural rock or soil material that combines one or more clay minerals with traces of metal oxides and organic matter. Geologic clay deposits are mostly composed of phyllosilicate minerals containing variable amounts of water trapped in the mineral structure. Clays are plastic due to their water content and become hard, brittle and non–plastic upon drying or firing. Depending on the soil's content in which it is found, clay can appear in various colours from white to dull grey or brown to deep orange-red. Although many naturally occurring deposits include both and clay, clays are distinguished from other fine-grained soils by differences in Size and mineralogy. Silts, which are fine-grained soils that do not include clay Minerals, tend to have larger particle sizes than clays. The study was aimed to manufacture clay brick doping with ceramic waste power in different ratio. The manufactured brick should meet essential values.

Fig. 1 Clay soil

MATERIALS:

Clay soil:

Clay is a finely-grained natural rock or soil materials that Combines one or more clay minerals with traces of metal oxides Organic matter.

Ceramic waste powder:

The ceramic industry inevitable generates wastes, irrespective of the improvements introduced in the manufacturing process, About 15%-30% production goes as waste from the total production. However the ceramic waste is durable, hard and highly resistant, The reuse of these waste ceramic powders , offers advantages such as reduction in the use of raw materials of clay brick, contributing to an economy of natural resources. Reuse of waste materials also offers benefits in the terms of energy. The partial replacement of ceramic waste powder in brick manufacturing process is to

(1) avoids the disposal of waste materials and minimises the use of natural resources, which implies energy savings and therefore, fewer carbon di oxide emissions,

(2) Allows the use of waste to replace higher cost materials,

(3) Improves some properties of bricks. In the light of recycling, this investigation examined the potential use of Ceramic waste powder that partially replaced in the clay material.

Constituents	Composition wt%
SiO_2	63.36
Al_2O_3	18.20
Fe_2O_3	2.77
CaO	1.74
Na_2O	0.34
K_2O	3.87
MnO	0.02
TiO_2	0.80
MgO	2.04
P_2O_5	0.05
PF	6.80

Table 1. Composition of Ceramic waste powder

Fig 2. Ceramic waste powder

Clay brick with ceramic waste powder:

The experimental investigation was carried out to find the optimum Mix percentage of clay brick with addition of ceramic waste powder like 5%, 10%, 15%, 20%, and 25%. Tests were performed for properties of clay bricks. The nominal clay bricks with the ratio of 100% clay as raw material. The clay soil and measured amount of ceramic powder are mixed with water. The prepared clay is well kneaded and moulded manually. The green clay bricks are dried in sunlight for 5 days and burnt in chamber for 12 hours. Finally, the bricks are taken out after 36 hours from the chamber.

Manufacturing of bricks:

The bricks which are partially replaced with ceramic powder are manufacture in ANDAVAR CHAMBER which is located at Arasur, Sathyamanglam.

The traditional brick manufacturing was employed to mix the raw materials. In brick preparation, the pure clay was changed into proper plasticity and the workability by mixed with water. Then the prepared clay manually doped with ceramic powder while adding water until proper mixing reached. The raw materials were put in a mould to get green brick. The green bricks were protected by saw dust to keep away from engaging with other newly prepared green bricks. These green bricks were kept to direct air dry under sunlight of temperature around for 5 days. Then the green bricks were burned in a chamber.

Fig 3 Brick making

TESTING OF BRICKS:

Bricks used at site are to be tested for quality to ensure their suitability for building construction.

Compressive strength test:

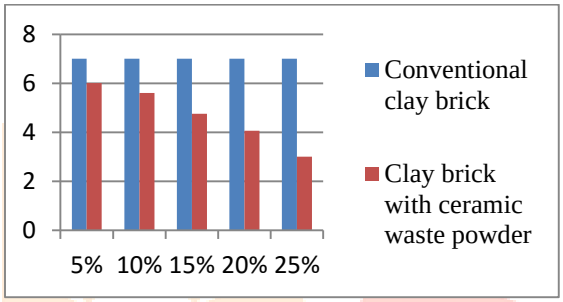
Compressive strength (N/mm^2) = Max. Load at failure in N /Ave. area of bed surface in mm^2

Bed surface =(210 * 95 * 75)mm

Area = 19950 mm^2

Fig. 4 Compressive testing

COMPARISON CHART:



Comparison chart for conventional clay brick and clay brick with ceramic waste powder

Water absorption test:

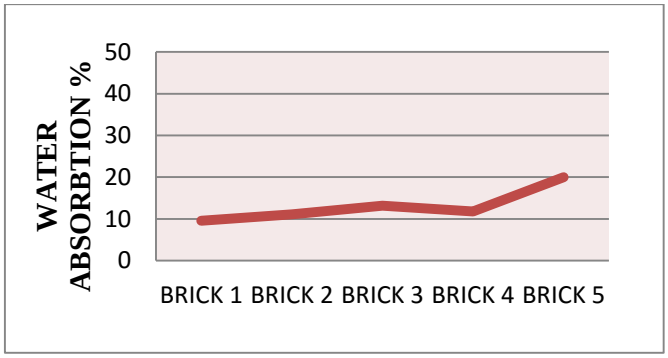
In this test bricks are weighed in dry condition and let them immersed in fresh water for 24 hours. After 24 hours of immersion those are taken out from water and wipe out with cloth. Then brick is weighed in wet condition. The difference between weights is the water absorbed by brick. The percentage of water absorption is then calculated. The less water absorbed by brick the greater its quality. Good quality brick doesn't absorb more than 20% water of its own weight.

Water Absorption = $((W_2 - W_1)/W_1)*100$

Fig. 5 Water absorption of brick

Brick type	(W_1)	(W_2)	Water absorption of brick (%)
5%	2.6	2.85	9.6
10%	2.7	3	11.11
15%	2.65	3	13.20
20%	2.55	2.850	11.76
25%	2.5	3.00	20

Table 2. Water absorption of brick in %



Graph representation of water absorption

RESULT:

From the result average % of water absorption is = **13.13%**

EFFLORESENCE TEST:

The presence of alkalis in bricks is harmful and they form a grey or white layer on brick surface by absorbing moisture. To find out the presence of alkalis in bricks this test is performed. In this test a brick is immersed in fresh water for 24 hours and then it's taken out from water and allowed to dry in shade. If the whitish layer is not visible on surface it proofs that absence of alkalis in brick. If the whitish layer visible about 10% of brick surface then the presence of alkalis is inacceptable range. If that is about 50% of surface then it is moderate. If the alkali's presence is over 50% then the brick is severely affected by alkalis.

HARDNESS TEST:

In this test a scratch is made on brick surface with a hard thing. If that doesn't left any impression on brick then that is good quality brick.

SOUNDNESS TEST:

In this test two bricks are held by both hands and struck with one another. If the bricks give clear metallic ringing sound and don't break then those are good quality bricks.

Fig 6.10 Soundness test of brick

CONCLUSION:

Based on the results obtained from the experiment the following conclusions are drawn.

1. The maximum compressive strength of clay brick with ceramic waste powder is obtained at 5% of replacement (6.01 N/mm2) and 10% of replacement (5.61 N/mm2).
2. The maximum strength attained at doping at low percentage than higher percentage.
3. The water absorption is lower than the normal conventional brick.

It can be concluded that the brick specimen doping with lower percentage of ceramic waste powder will not only relieve the environmental burden but also result into a more sustainable and economical construction.

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