# Utilization of Waste Ceramic for Brick in Unsuitable Soil

Shyam Doshi[1], Kakadiya Khushal[2], Khasatiya Manoj[3], Limbasiya Ashish[4], Padmani Chirag[5]
[1]*Asst.Prof. Civil Engineering Department, BMCET, Vesu, Surat, Gujarat, INDIA*
[2, 3, 4, 5] *Civil Engineering Department, BMCET, Vesu, Surat, Gujarat, INDIA*

***Abstract*- In the world, large quantities of ceramic wastes being generated as most of ceramic industries produce the ceramic wastes. The ceramic waste which is a resource material. The ceramic wastes are not well managed or utilized may pose environmental challenges. The ceramic wastes were dumping them in open field and it's generate the environmental pollution. These wastes can be recycling. In this project was to compare the compressive strength of the bricks, so for this purpose different percentage of ceramic waste material were separately added by weight, and then incorporate in brick making. This review describes change in the physical properties such a weight, density etc.**

***Index Terms*- Ceramic Waste, Brick, Unsuitable Soil, Waste-Create Bricks(WCB), Clay**

## I. INTRODUCTION

Bricks are one of oldest method known and used for building materials dating back to 7000BC where they were first found in southern Turkey and around Jericho. It is a block of ceramic material used for construction due to its heat resistant material and components. Bricks are one of the oldest types of technique and method used by mankind. The first bricks that were dried through the use of sun in ancient time were mud bricks made in Mesopotamia aka Iraq now. They are said to be one of the oldest building materials used for construction because of it being cheap, durable, and easy to handle. Another reason it is commonly used is that it's easily available in the market place. Brick is building material used to build walls, paving materials and other components in masonry construction. Traditionally, the term brick refers to as a unit of clay sample fired in large temperature by making into rectangular blocks. The most used raw materials in the traditional brick industries can be basically divided into three categories, plastic components (clays), fluxing components (feldspar), and inert components (quartz and sand). A good quality bricks is one which gives good compressive strength and less water absorption, without any defects or cracks formed in the bricks. The following parameters viz., compressive strength, water absorption, efflorescence, bulk density, hardness, size, shape, colour, soundness and structure were used to assess the quality of brick for construction based on Indian Standards given. Many researchers in the past decades found experimentally that the addition of ceramic waste powder in the clay sample improves the durability of the brick. The addition of ceramic waste powder in unsuitable brick soil is not only economical and also eco friendly. Normally bricks are made up of clay sample only and in some of the best research papers it is observe that bricks are made by mixing clay sample and different proportions of ceramic waste powder. In this subject field, the different proportions of ceramic waste powder are mixed with unsuitable brick soil to examine the effects on index properties and mechanical properties. The different proportions considered are 0%, 10%, 20%, 30%, 40%, & 50%. A brick is a block made of clay, burnt in a kiln.

*Objectives*

Like this type of ceramic waste beneficial application in various engineering fields through which the environment & natural resources can be save. Use of ceramic waste in building material can reduce consumption of resources such as clay and lessen the burden of its impact on environment. To Check the physical properties of clay brick like compressive strength, water absorption.

## II. MATERIAL & METHODOLOGY

*Clay*:

The most of bricks used are made from clay and shale. The clay shall be free from stones, gravel, coarse sand and modular lime. The chemical analysis of the clays shall be conducted in accordance with IS

1727 :1967 and IS 2720 (part 21): 1977.The plastic properties of the clay shall be determined by determining the plasticity index by the method given in IS 2720 (Part 5) :1985. The range of plasticity index will be 15 to 30.

*Ceramic Waste*:

The ceramic industry generates wastes, irrespective of the improvements introduced in manufacturing processes. In the ceramic industry, about 15%-25% production goes as waste.These wastes pose a problem in present day society, requiring a suitable form of management in order to achieve sustainable development.In this research study the clay has been replaced by ceramic waste accordingly in the range of 10%, 15%, 20%, 25%,30% by weight.Ceramic material is hard and rigid. It is estimated that 10 to 30% waste are produced of total raw material used

Table 1.1 Chemical Composition of Ceramic Waste

| Composition | Percentage% |
|---|---|
| $Si_2O$ | 82.7 |
| $AL_2O_3$ | 8.53 |
| $Fe_2O_3$ | 4.88 |
| CaO | 0.36 |
| MgO | 0.58 |
| $Na_2O$ | 1.4 |
| $K_2O$ | 0.02 |

*Water*:

Potable water is required for casting and curing of concrete mixes. Water cover 71% surface of the Earth. Water on Earth moves continuously through water cycle. Water is transparent fluid and it contains one oxygen and two hydrogen atoms that are connected by covalent bonds. Water is important ingredient of cement concrete and most useful for construction work. Density of water is 999.97 $kg/m^3$, Triple point temperature of water is 0.01 ℃,Formula of water is $H_2O$, Melting point of water is 0℃ , and Boiling point of 4water is 99.97℃ .

*Sand:*

Sand is important material of the construction and must be purchased with all care and vigilance. Sand is a naturally occurring granular material composed of finely divided rock. Sand is classified by size like Fine sand (0.075 to 0.425 mm), Medium sand (0.425 to 2 mm), and Coarse sand (2.0 to 4.75mm).Manufacturing plants add sand to a mixture of clay and other material for manufacturing bricks. Different type of sand like Pit sand, River sand, Sea sand.

In first stage of manufacturing of brick, the clay is excavating from ground with the help of heavy machineries. After that, clay is transport to the manufacturing site. The water and sand are adding to the clay with the help of manpower. After that, wetted sandy clay fill into the mold. Then that molds are put in the sunlight for few days. After that, that mold is put in the fire kiln. Then bricks are stacking on the ground. Finally, they are ready for use.

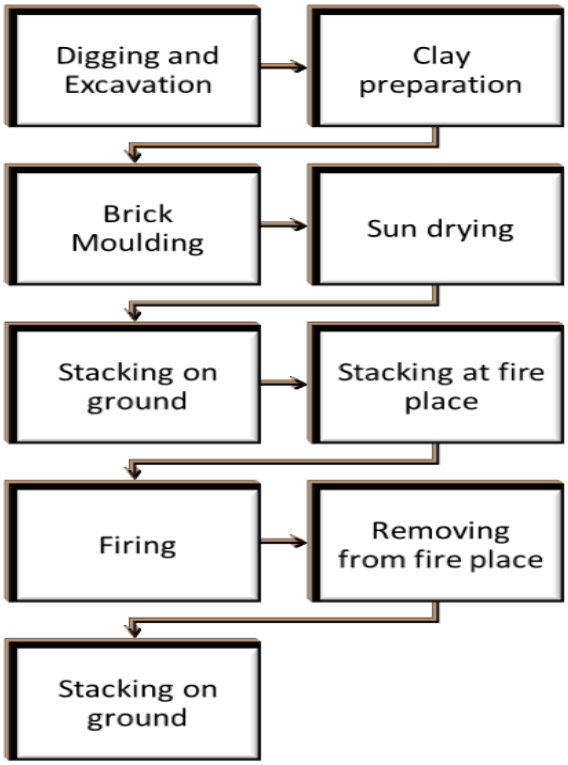



Fig 1.1: Flow chart of manufacturing process

## III. RESULT ANALYSIS

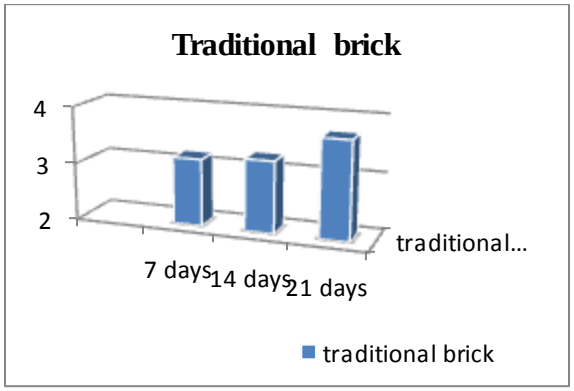
Unevenness observed in the bed faces of bricks is removed to provide two smooth and parallel faces by grinding. It is immersed in water at room temperature for 24 hr. The specimen is then removed and any surplus moisture is drained out at room temperature. The frog and all voids in the bed face are filled with cement mortar (1 cement, clean coarse sand of grade 3 mm and down). It is stored under the damp jute bags for 24 h followed by immersion in clean water for 3 days. The specimen is placed with flat faces

horizontal, and mortar filled face facing upwards between two 3 ply plywood sheets each of 3 mm thickness and carefully centered between plates of testing machine. Load is applied axially at a uniform rate of 14 N/mm$^2$ per minute till failure occurs. The maximum load at failure is noted down. The load at failure is considered the maximum load at which the specimen fails to produce any further increase in the indicator reading on the testing machine.

Fig. 1.2 automatic compression testing machine

Table 1.2 Compression Test Results for traditional bricks

| Label | 7 Days N/mm$^2$ | 14 Days N/mm$^2$ | 21 Days N/mm$^2$ |
|---|---|---|---|
| 1 | 2.95 | 3.63 | 3.86 |
| 2 | 3.40 | 3.18 | 4.09 |
| 3 | 3.18 | 2.95 | 3.18 |
| Avg. | 3.17 | 3.25 | 3.71 |




Graph 1: Compression Test results for Traditional Bricks

Table 1.3 Compression Test Results for 10% Replacement of red soil

| Label | 7 Days N/mm2 | 14 Days N/mm2 | 21 Days N/mm2 |
|---|---|---|---|
| 1 | 3.86 | 4.54 | 5.68 |
| 2 | 4.54 | 5.22 | 5.45 |
| 3 | 4.09 | 5.90 | 5.00 |
| Avg. | 4.163 | 5.220 | 5.376 |

Table 1.4 Compression Test Results for 20% Replacement of red soil

| Label | 7 Days N/mm2 | 14 Days N/mm2 | 21 Days N/mm2 |
|---|---|---|---|
| 1 | 4.09 | 5.00 | 5.22 |
| 2 | 3.86 | 5.22 | 5.00 |
| 3 | 4.31 | 4.31 | 5.45 |
| Avg. | 4.086 | 4.843 | 5.223 |

Table 1.5 Compression Test Results for 30% Replacement of red soil

| Label | 7 Days N/mm2 | 14 Days N/mm2 | 21 Days N/mm2 |
|---|---|---|---|
| 1 | 4.09 | 5.45 | 5.00 |
| 2 | 4.54 | 5.68 | 5.68 |
| 3 | 4.31 | 4.77 | 5.90 |
| Avg. | 4.313 | 5.300 | 5.526 |

Table 1.6 Compression Test Results for 10% Replacement of black cotton soil

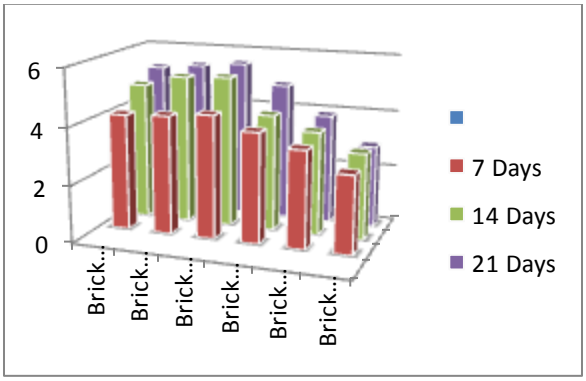
| Label | 7 Days N/mm2 | 14 Days N/mm2 | 21 Days N/mm2 |
|---|---|---|---|
| 1 | 3.86 | 4.09 | 4.54 |
| 2 | 3.63 | 3.86 | 4.77 |
| 3 | 4.09 | 4.31 | 5.22 |
| Avg. | 3.860 | 4.086 | 4.843 |

Table 6.6 Compression Test Results for 20% Replacement of black cotton soil

| Label | 7 Days N/mm2 | 14 Days N/mm2 | 21 Days N/mm2 |
|---|---|---|---|
| 1 | 3.63 | 3.40 | 3.86 |
| 2 | 3.40 | 3.86 | 3.63 |
| 3 | 3.18 | 3.63 | 4.09 |
| Avg. | 3.403 | 3.630 | 3.860 |

Table 6.7 Compression Test Results for 30% Replacement of black cotton soil

| Label | 7 Days N/mm2 | 14 Days N/mm2 | 21 Days N/mm2 |
|---|---|---|---|
| 1 | 2.72 | 2.50 | 3.18 |
| 2 | 2.50 | 3.18 | 2.5 |
| 3 | 2.95 | 3.40 | 2.95 |
| Avg. | 2.723 | 3.026 | 2.876 |




Graph 2 Compression Test results for bricks replacing ceramic waste

## III. CONCLUSION

- After this project we conclude that, if we replace ceramic waste with black sand and red sand is directly affected to the strength of the brick.
- We found that in number three brick we got more strength compare to another proportion.
- We also found that black cotton soil with ceramic waste give more strength.
- If we replace ceramic waste by black cotton soil strength is reduce.
- We also found that colour of the brick is comparatively good and soundness of the brick is also good.
- So we easily conclude that 10%,20% and 30% replacement of red soil give good strength and we can reduce the cost of project and effective use of waste material is carried out.

## IV. ACKNOWLEDGMENT

We are extremely thankful to BHAGWAN MAHAVIR COLLEGE OF ENGINEERING & TECHNOLOGY for providing us a chance to increase our knowledge and for providing us a chance to show our talent by this project work. It is our pleasure and happiness to express thanks and profound gratitude to our project guide Prof. SHYAM DOSHI for his valuable guidance and continues encouragement throughout the project. We are hardly thankful to him for his time to time suggestion and the clarity of concept of the topic that helps a lot during this study. We also sincerely thankful to him for the time spent in classmates and all the faculty of civil engineering department.

The all group members, who are always helpful during the practical and motivated each other throughout the project duration, we are thankful to each another also for this. Most importantly, we express gratitude towards our family, for their endless love and moral support.

## REFRENCE

[1] IS: 3495 – P (1)-1992
[2] IS: 3495 – P (2)-1992
[3] "Concrete Technology", M.L.Gambhir, McGraw -hill Book Company
[4] "Concrete Technology" M.S. Shetty, S. Chand Company,
[5] "Waste Materials andby Products", R Siddique.
[6] IS 2117-1991 Guide for Manufacture of Hand-made common burnt Clay building Bricks.
[7] IS 3495-1992 PART-1, Methods of test of burnt clay building bricks-Specification for Finding Compressive Strength of Brick.
[8] IS 3495-1992 PART-2 Methods of test of burnt clay building bricks-Specification for Finding Water Absorption Percent.
[9] IS 3495-1992 PART-3 Methods of test of burnt clay building bricks- Specification Efflorescence for Brick.
[10] S. Dhanapandian, M.Shanthi, C.Manoharan, T. Ramkumar and A .Deiveegan. 'Investigation of Granite waste incorporated clay bricks as a building material" in International Journal of Recent Scientific Research in IJRS: Vol. 4, PP. 107-113, August 2010.
[11] S. Dhanapandian and B. Gnanavel carried on 'experiments using granite and marble sawing powder wastes in the production of bricks using Spectroscopic and Mechanical Analysis" in Research Journal of Applied Sciences, Engineering and Technology 2(1), 73-86, published on January 2010