

# REPLACEMENT AND ANALYSIS OF CLAY BRICKS BY REPLACEMENT OF CLAY WITH INDUSTRIAL WASTES AND MSAND

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**Abstract** - The objective of our project is to utilize the locally available waste material as a replacement for clay in clay burnt bricks. Due to the excessive use of clay as a building material, it is at a verge of extinction. Hence there is a need for alternative building material with same properties of brick. Various locally available waste materials which can bond with clay to produce required hardness is selected and is replaced in the place of clay in the clay burnt bricks. The different proportions in which the waste materials are replaced in place of clay is selected based on its property and literatures referred. These waste materials are chosen on the basis of its availability and abundance. These waste materials are a threat to environment and hard to dispose. In this project 4 materials are selected as a replacement for clay. M Sand which is already used as replacement for river sand is tested for making clay bricks. Rice husk ash (RHA) has very low density and can used to obtain light weight bricks. The residue materials which are left after burning the bricks in the kiln such as kiln sand and wooden ash is used as a replacement for clay. They are prepared in the casting yard and tested in the laboratory for its fundamental properties as per IS 3495:1992. The results are examined and compared with the nominal bricks which are being used in the construction field. Based on the study, various suggestions are made regarding the usage these waste materials as a replacement for clay in clay burnt bricks.

**Key Words:** Clay bricks, Clay, Industrial waste, Msand

## 1.INTRODUCTION

A brick is artifact wont to create walls, pavements and other elements in masonry construction. Traditionally, the term brick referred to a unit composed of clay, but it is now used to denote any rectangular units laid in mortar. A brick will be composed of clay-bearing soil, sand, and lime, or concrete materials. Bricks area unit created in various categories, types, materials, and sizes which vary with region and time period, and are produced in bulk quantities. Two basic classes of bricks area unit discharged and non-fired bricks. Fired bricks area unit one among the longest-lasting and strongest building materials, typically mentioned as artificial stone, and have been used since circa 4000 BC. Air-dried bricks, conjointly referred to as mud bricks, have a

history older than fired bricks, and have an additional ingredient of a mechanical binder such as straw. Bricks area unit ordered in courses and various patterns referred to as bonds, collectively known as brickwork, and may be laid in various kinds of mortar to hold the bricks together to make a durable structure.

## 2. METHOD OF MANUFACTURE

Three basic types of brick are un-fired, fired, and chemically set bricks. Each type is manufactured differently.

### 2.1 Fired brick

Fired bricks area unit burned during a oven that makes them sturdy. Modern, fired, clay bricks area unit shaped in one among 3 processes – soft mud, dry press, or extruded. Depending on the country, either the extruded or soft mud method is the most common, since they are the most economical.

### 2.2 Shaping methods

Three main ways area unit used for shaping the raw materials into bricks to be fired: wrought bricks – These bricks begin with raw clay, preferably in a mix with

- 25–30% sand to reduce shrinkage. The clay is initial ground and mixed with water to the required consistency. The clay is then ironed into steel moulds with a press. The formed clay is then discharged ("burned") at 900– a thousand °C to attain strength. Dry-pressed bricks – The dry-press technique is analogous to the soft-mud

- molded method, but starts with a much thicker clay mix, so it forms more accurate, sharper-edged bricks. The bigger force in pressing and also the longer burn create this technique dearer. Extruded bricks – For extruded bricks the clay is mixed with 10–

- V-day water (stiff extrusion) or 20–25% water (soft extrusion) in an exceedingly pugmill. This mixture is forced through a die to create a long cable of material of the desired width and depth. This mass is then dig bricks of the required

length by a wall of wires. Most structural bricks area unit created by this technique because it produces laborious, dense bricks, and suitable dies can produce perforations as well. The introduction of such holes reduces the amount of clay required, and hence the cost. Hollow bricks area unit lighter and easier to handle, and have different thermal properties from solid bricks. The cut bricks area unit hardened by drying for twenty to forty hours at fifty to one hundred fifty °C before being discharged. The heat for drying is usually waste heat from the oven.

### 2.3 Kilns

In several trendy brickworks, bricks area unit sometimes dismissed during unendingly dismissed tunnel oven, with in which the bricks area unit dismissed as they creep through the oven on conveyors, rails, or oven cars, that achieves a additional consistent brick product. The bricks typically have lime, ash, and organic matter added, which accelerates the burning process. Fig 1. Staked Bricks Fig 2. Bricks Ready for Kiln Burning The other major kiln type is the Bull's Trench Kiln (BTK), based on a design developed by British engineer W. Bull in the late 19th century. An oval or circular trench is dug, 6–9 meter wide, 2–2.5 meter deep, and 100–150 meters in circumference. A tall exhaust chimney is constructed in the centre. Half or additional of the ditch is stuffed with "green" (unfired) bricks that area unit stacked in AN open lattice pattern to permit flow. The lattice is capped with a roofing layer of finished brick.

### 3. OPTIMAL DIMENSIONS, CHARACTERISTICS, AND STRENGTH

#### Standard Imperial Metric

Australia nine × 4 $\frac{1}{3}$  × three in 230 × a hundred and ten × seventy six metric linear unit Kingdom of Denmark nine × 4 $\frac{1}{4}$  × 2 $\frac{1}{4}$  in 228 × 108 × fifty four metric linear unit Deutschland nine × 4 $\frac{1}{4}$  × 2 $\frac{3}{4}$  in 240 × one hundred fifteen × seventy one metric linear unit Asian country nine × 4 $\frac{1}{4}$  × 2 $\frac{3}{4}$  in 228 × 107 × sixty nine metric linear unit Balkan nation nine × 4 $\frac{1}{4}$  × 2 $\frac{1}{2}$  in 240 × 115 × 63 mm Russia 10 × 4 $\frac{3}{4}$  × 2 $\frac{1}{2}$  in 250 × 120 × 65 mm South Africa 8 $\frac{3}{4}$  × 4 × 3 in 222 × 106 × 73 mm United Kingdom 8 $\frac{1}{2}$  × 4 × 2 $\frac{1}{2}$  in 215 × 102.5 × 65 mm United States 7 $\frac{5}{8}$  × 3 $\frac{5}{8}$  × 2 $\frac{1}{4}$  in 194 × ninety two × fifty seven metric linear unit

### 4. LITERATURE REVIEW

Sutas Janbuala and Thanakorn Wasanapiarnpong (13, july 2016) stated that an increase in bagasse content results in a decrease in the compressive strength of the specimen, an increase in firing temperature leads to an increase in density and compressive strength.

An increase in pulp content conjointly leads to exaggerated body and absorption of specimen. In contrast, porosity and absorption decrease with an increase in firing temperature. M.A. Gafur, Sudip Shaha(August 19-20, 2015) stated that for the same size of coal the bulk density decreases linearly with the increase of coal content. For the Same percentage of coal content bulk density is higher in specimen containing finer coal and vice versa. The thermal conductivity and cold crushing strength decreases with the increase of coal content. Also cold crushing strength is affected by the size of coal. Mohammad Shahid Arshad, Dr. P.Y. Pawade (6, JUNE 2014 ) stated that elemental analysis of paper mill waste by X- Ray Fluorescence (XRF) shows that silica content is highest in PMW is 22.36% and silica participates in reaction to form cementitious material. It is observed that as the temperature increases the compressive strength of bricks is also increases and as the percentage of the soil reduces the strength of the brick decreases.

It is noted that because the clay content is reduces the bricks become lighter in weight.

At the composition wherever the soil content is just half-hour, then the waste material comprises of paper mill waste and orange peel does not make a good bond with each other and it crumbles only it's entirely dried. Orange peel does not make bond with paper mill waste and soil and thus, it is not a good binding

agent and it cannot be used as an ingredient for construction purpose. Prof. Niklesh R. Murekar, Prof. Roshan S. Satpute, (21-22 January 2017) stated that different methods are studied for producing bricks from waste materials can be divided into categories like firing and cementing. The firing and cementing for producing bricks from waste materials still have the drawbacks of high energy consumption and large carbon footprint as the conventional brick production methods. For wide production and utilization of bricks from waste materials, further research and development is needed, not only on the technical, economic and environmental aspects but also on standardization, government policy and public education. Halil Murat Algin , Paki Turgut (August, 2006) stated that the test results show that the CW-LPW combination provides results, which are of potential for this combination to be used in the assembly of lighter and economical new brick material.

The observations during the tests show that the effect of 10–40% CW replacements in CW-LPW matrix does not exhibit a sudden brittle fracture even beyond the failure loads and indicates high energy absorption capacity by allowing lower labouring cost. This CW-LPW composition produces a sturdy lighter composite, which is about 60% lighter than the conventional concrete bricks. Zoltán Gyurkó<sup>a,\*</sup>, Anna Szijártó<sup>a</sup>, Rita Nemes<sup>a</sup> (September, 2015) stated that the clay brick powder has no significant effect on the strength of concrete or on its durability.

The cellular concrete powder is ready to extend the compressive strength considerably (37%) and it's a positive impact on the sturdiness performance of the concrete similarly. Based on the freeze test, the concrete with cellular concrete powder lost less than 5% of its compressive strength after 150 cycles of freezing. Swetha Madhusudanan and Lilly Rose Amirtham (March, 2015) stated that addition of air entraining agents results in good insulating property and is effective as a sound barrier. Energy saving generated by the newly developed building block reduces HVAC tonnage requirements due to the porous nature of the block and its low U Value (0.265 W/mK). Reduced usage of cement leads to lesser CO<sub>2</sub> emissions to the atmosphere. Usage of natural resources like river sand and gravel is also reduced by the replacement of industrial waste. Dr. Mohamed Najjar P.A (January 2016) stated that substantial reduction in the total weight of walls and partitions in multi storied buildings; thus reducing the foundation costs and total building cost. The presence of all through tiny air filled cells provides excellent acoustic performance of foamed bricks and they are highly suitable for partition walls, floor screens / roofing and panel material in auditorium. The low thermal conduction of LWFB provides low thermal exchange between inner and outer part conditions.

Rajagopalan Varadarajan and Venkatesan Govindan (July 2013) stated that the results emphasize the positive effect of bagasse ash and granite waste on brick samples that reach its optimum at 20% waste incorporation, while at higher percentages, agglomeration of wastes started and granite wastes, generated by the process industries, as alternative raw materials in the production of bricks. The average compressive strength obtained at 10% by weight is higher than that of other waste weight percentage. Also the compressive strength obtained at 20% by weight is similar to that of clay brick. Homan Jamuda (March, 2014) stated that the samples with Sludge content of 30- 40% was found to be vitrified. A ratio of 2:3:3:2 containing fly ash, cement, and sludge and demolition waste, respectively was found to be the better suitable ratio in manufacturing brick made of sludge and demolition waste along with fly ash and also has a potential to be used as rather than traditional bricks. While a number of the properties of the designed brick with the quantitative relation of 2:3:3:2 was found to be completely fine, some weren't. Such as compressive strength of the brick was 15.88 MPa, whereas the normal brick strength lies in the range of 7.5-10 MPa. [3] The bulk density of it was found to be 2.62 g/cm<sup>3</sup>, whereas a normal brick has a density of 1.8-2 g/cm<sup>3</sup>. [4] The properties like pH was found to be 6.7 which wasn't appropriate enough as normal bricks have pH of 8.5-10.5 [4].

The samples and their properties were conjointly checked per the IS: 1077 -1992 and IS: 2212 - 1991, the Code of follow for brick work to be used.

## 5. METHODOLOGY

- Mixing Clay at Desired Proportion
- Casting Sun Drying
- Demoulding
- Kiln Burning
- Testing the brick samples
- Analyses & Discussion
- Collecting Materials for Mixing Results

## 6. TEST ON BRICKS

### 6.1 TEST FOR DENSITY

The most fundamental property of the brick is its density. The density is defined as the ratio of the weight of the brick to the volume of the brick. The weight of the brick is measured by placing it on the weighing machine after completely drying it. The most economical brick is identified by its weight and strength. Hence the density of the brick is identified to determine the effectiveness of the brick.

### 6.2 CRUSHING STRENGTH TEST

Place the specimen 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 the testing machine. Apply load axially at a uniform rate Fig 15. UTM Testing (1) Fig 16. UTM Testing (2) of 14 N/mm<sup>2</sup> (140 kgf/cm<sup>2</sup>) per minute till failure occurs and note the maximum load at failure. The load at failure shall be the utmost load at that the specimen fails to provide any longer increase within the indicator reading on the testing machine.

### 6.3 WATER ABSORPTION TEST

The bricks which are casted are need to checked for its water absorbing property. If the bricks absorb a large quantity of water, then the strength of the mortar that is applied over is reduced. The moisture in the mortar will be largely absorbed by the bricks. Hence the water absorbing property of brick need to be tested as per IS code. The brick samples are immersed in water after drying it completely.

### 6.4 NOMINAL BRICK

The standard brick with no replacements is weighed before and after being dipped in water. The resulting weight of the brick is compared with the weight of the before dipping into water and the percentage of water absorbed.

## 7. M SAND REPLACED BRICKS

Based on the test results and analyses, M Sand is suggested to be an effective replacement for clay in clay burnt bricks. M Sand is found to improve the compressive strength of brick. It gradually increases and attains its maximum value of 7.5 MPa at 20% replacement of M Sand which is more than that of a nominal brick. But on further increase to 25% results in the decrease in compressive strength of the bricks. The water absorption studies show that the bricks perform good in these tests. All combination of bricks with M Sand replacement is found to have a water absorption percentage of 10% which is equal to those values of nominal bricks. And also the efflorescence test proved that there is no salt formation on the surface of bricks with the moisture attack. The density of brick tends to increase with the addition of M Sand in the place of clay. If the type of construction doesn't have much importance to the weight of the structure, then these bricks can be well suited. The cost of M Sand is also very less as compared to clay and thus reducing the cost of construction. Hence it is suggested that 20% M Sand replaced bricks can be used as a substitute for normal clay bricks as a construction material.

## 8. CONCLUSION

The main objective of the project is to study the characteristics of the clay burnt brick when the main component clay is replaced with various locally available waste materials. These materials are selected based on their feasibility to avail and their property to bond with the clay. Their proportions of replacement are arrived from the literatures studied and they are casted in the casting yard with prior quality. These bricks are successfully tested for their fundamental properties as per IS 3495 – 1992. Those results are completely analyzed and various conclusions are made with respect to the desired properties of standard bricks. The conclusions and suggestions made are briefly explained in this chapter.

## 9. REFERENCES

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