

EXPERIMENTAL STUDY ON POROTHERM BRICK USING GRANITE POWDER

R. Soundarya devi¹, V. Mohana priya², C. Saranya³, M. Selvalakshmi⁴

^{1,2,3,4}UG Student, Renganayagi Varatharaj College of Engineering, Salvarpatti, Tamilnadu, India.

Abstract - Bricks are widely used construction and building material around the world. In this study, bricks are prepared from natural waste material which comprises of granite powder and rice husk ash. The main objective of this study is to reduce the quantity of clay with natural waste material. On the other side, proper and efficient disposal of natural waste is being the key factor in solid waste management in most of the Indian states. So, we are efficiently replacing the significant quantity of granite powder (2%, 4% & 6%) and rice husk ash (1%) in making lightweight brick in appropriate proportions which gave compressive strength as similar as conventional brick. The average water absorption ratio and compressive strength obtain in this study are 13.7% and 8.5 N/mm² respectively.

Key Words: Porotherm brick, rice husk ash, granite powder, compressive strength, water absorption test, light weight brick, thermal insulation.

1. INTRODUCTION

Porotherm is the clay brick which is used for the masonry works. It acts a light weight infill material. Construction block technology offers a speedier, cost effective, environmentally sound alternative to conventional walling material. The brick is the main material in construction due to strengthen, durability, loading, compactness and lightweight. This brick provides excellent thermal insulation that is 45% higher than conventional walling material. Also it has an exceptionally long life with zero maintenance. It improves the speed of construction without compromising on quality and safety. It would reduce its weight as well as selling price and makes its more affordable.

There is a great impact in worldwide towards recycling industrial waste by-products and their utilization as renewable construction materials. Leaving the waste material to the environment directly, can cause environment problems. Wastes can be used to produce a new product or can be used as admixtures so that natural source are used more efficiently and the environment is saved from waste deposits.

So, in this study rice husk ash and granite powder is added to the clay. During the cutting and polishing process, about 25% of granite is resulted in dust, mainly composed of SiO₂, Al₂O₃, FeO₃ and CaO, with some minor constituents such as Mg, Ti, Mn and K oxides, which can cause serious damage to the environment.

2. OBJECTIVE

The main objective is:

- To study the characteristics of granite powder in the porotherm brick.
- To compare the compressive strength of porotherm brick with conventional brick.
- To reduce the cost.
- To make the efficient use of building material.

3. DESCRIPTION OF POROTHERM BRICKS

Offering exceptionally fast, virtually dry construction, plus high strength and thermal efficiency. Porotherm is a modern clay brick structural walling system with reassuringly traditional values. A porotherm brick is ideally used from single storey to multi-storeys.

Porotherm brick is a technologically advanced smart clay brick or walling material designed for all types of buildings such as multi-storey buildings, individual houses, large apartments, villas, educational institutions, hospitals, hotels and commercial complexes etc. It is an innovative product specially created for changing climatic conditions, keeping homes naturally cool and comfortable throughout the year.

Also these bricks are environment friendly, cost effective and easy to handle. It have perforations as an integral design component to allow better thermal insulation for keeping homes naturally cool. It is naturally strong; they provide exceptionally long life with zero maintenance.

The inherent strength of the porotherm brick makes the product fire resistant-which means it does not burn, as it is already fired at 1000 degrees centigrade and has a fire rating of F240 (240 minutes). Since one porotherm brick is equal to the space occupied by nine small ordinary bricks, leading to less mortar usage, making porotherm a favourite with builder's architects alike.

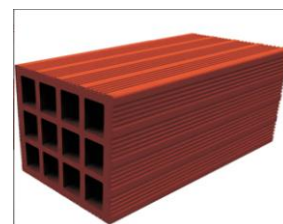


Fig 1-porotherm brick

4. MATERIALS USED

4.1 CLAY SOIL:

Clay soils are compounds of silica and alumina. Calcareous clays have calcium carbonate and will burn to a yellow or cream color. Non-Calcareous typically contain feldspar and iron oxides and will burn to a brown, pink or red depending on the amount of iron oxide.

It is a finely-grained natural rock or soil material that combines one or more clay minerals with traces of metal oxides and organic matter. It is plastic due to their water content and become hard, brittle and non-plastic upon drying or firing.



Fig 2 – Clay

4.2 GRANITE POWDER:

Granite powder is a byproduct produced in granite polishing industries while cutting into desired shapes. It belongs to the igneous rock family. Granite industry produces around 18 million tones waste per annum. The physical properties of granite powder is similar to the natural sand, hence it can be used in replacement of natural sand. Granite powder is locally available waste material hence it is possible to make economical brick.

Granite powder is a material which was taken from granite polishing industry. The percentage of granite powder added in the clay is 2%, 4% and 6%.



Fig 3- Granite powder

4.3 RICE HUSK ASH:

Rice milling industry generates a lot of rice husk during of milling of paddy which comes from the fields. This rice husk ash is mostly produced by burning rice husk between 600-

700 degree Celsius temperatures for 2 hours. Rice husk ash is about 25% by weight of rice husk when burnt in boilers. It is estimated that about 70 million tones of rice husk ash is produced annually worldwide.

This husk contains about 75% organic volatile matter and the balance 25% of the weight of this husk is converted into ash during the firing process, is known as rice husk ash (RHA). It consists of non-crystalline silicon dioxide (SiO₂).



Fig 4 – Rice Husk Ash

5. SPECIMEN TEST

It is necessary to check the quality of brick before using it in any construction activities. There are some field tests, that we can conduct in the field in order to check the quality of bricks. The tests are as follows:

- Water absorption test.
- Compressive strength test.

5.1 WATER ABSORPTION TEST:

The water absorption test on bricks is conducted to determine durability property of bricks such as degree of burning, quality and behavior of bricks in weathering. A brick with water absorption of less than 7% provides better resistance to damage by freezing.

The water absorption by bricks increase with increase in pores. The degree of compactness of bricks can be obtained by water absorption test, as water is absorbed by pores in bricks. So, the bricks, which have water absorption less than 3% can be called as vitrified. This test provides the percentage of water absorbed by the brick and it should not exceed 20% of average weight of dry bricks.

Water Absorption (%) =

Wet Weight (W₂)-Dry Weight (W₁)

Dry Weight (W₁)

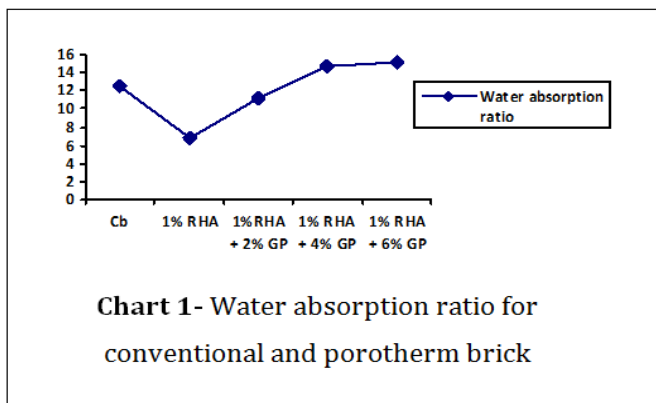
Test results :

Table 1-water absorption ratio for porotherm brick

Mix design ratio	Weight of brick (in Kg)	Weight of brick after absorbing water(in Kg)	% of water absorption
1% rice husk ash + clay	3.95	4.2	6.69
1% rice husk ash + 2% granite powder + clay	4.0	4.45	11.25
1% rice husk ash + 4% granite powder + clay	4.15	4.75	14.75
1% rice husk ash + 6% granite powder + clay	4.3	4.9	15.2

Table 2-water absorption ratio for conventional brick

Mix design ratio	Weight of brick (in Kg)	Weight of brick after absorbing water(in Kg)	% of water absorption
Trial 1	3.0	3.25	12.2
Trial 2	3.25	3.5	12.4
Trial 3	3.5	3.7	12.6



Cb – Conventional brick
 RHA – Rice Husk Ash
 GP – Granite powder

5.2 COMPRESSIVE STRENGTH TEST:

Compressive strength test on bricks are carried out to determine the load carrying capacity of bricks under compression. This test is carried out with the help of Compression Testing Machine.

Bricks are generally used for construction of load bearing masonry walls, columns and footings. These load bearing masonry structures experiences mostly the compressive loads. Thus, it is important to know the compressive strength of bricks to check for its suitability for construction.

$$\text{Compressive strength (N/mm}^2\text{)} =$$

$$\frac{\text{Maximum load at failure in N}}{\text{Avg. area of the bed faces in mm}^2}$$

Test results:

Table 3-Compressive strength for porotherm brick

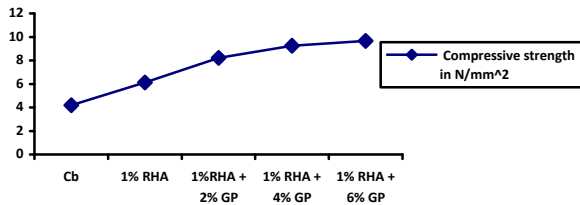
Mix design ratio	Load (in KN)	Compressive strength (in N/mm ²)
1% rice husk ash + clay	3.95	4.2
1% rice husk ash + 2% granite powder + clay	4.0	4.45
1% rice husk ash + 4% granite powder + clay	4.15	4.75
1% rice husk ash + 6% granite powder + clay	4.3	4.9

Table 4-Compressive strength for conventional brick

Mix design ratio	Load (in KN)	Compressive strength (in N/mm ²)
Trial 1	70	4.1
Trial 2	85	4.25
Trial 3	80	4.2

Chart 2 – Compressive strength of conventional brick

and porotherm brick



Cb – Conventional brick
 RHA – Rice Husk Ash
 GP – Granite powder

6. CONCLUSIONS

Based on the present study, which is conducted on production of porotherm brick from natural waste materials, we conclude that:

- In porotherm brick, it is possible to add granite powder and rice husk ash including water.
- Usage of granite powder and rice husk ash has reduced the weight and cost of brick.
- Both rice husk ash and granite powder is a good binding agent with clay.
- Porotherm brick absorbed 12% of water which is small quantity when compared with conventional bricks.
- In 1% rice husk ash and 2% granite powder the compressive strength is 8.3N/mm² in comparison with conventional brick.
- In 1% rice husk ash and 4% granite powder the compressive strength is 9.25 N/mm² in comparison with conventional brick.
- In 1% rice husk ash and 6% granite powder the compressive strength is 9.25 N/mm² in comparison with conventional brick.
- In compared with conventional brick, the compressive strength of porotherm brick is high.

7. REFERENCES

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