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# An Experimental study of clay brick using polystyrene

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**Abstract -** This project is about combining Polystyrene with the raw materials of bricks. Majority of people prefer burnt brick for construction purpose, and to make some improvements in its strength, thermal resistive property, reduce the weight of brick and other properties a raw material called Polystyrene is added to the raw material of brick at various percentages like 5%, 10%, and 15%. Polystyrene ball is solid hydrocarbon substance and it is added to the clay in its solid state itself. By adding this material at various percentage the behaviour of brick is checked at various percentage and various tests like compressive strength, water absorption test, are performed and its properties are compared with that of the conventional brick. And addition of polystyrene makes the brick a good thermal insulator, sound absorber, less weight, and absorbs vibration.

***Key Words*: polystyrene, thermal resistive, hydrocarbon, bricks, sound absorber.**

## 1. INTRODUCTION

Light weight concrete was popular through the ages, Light weight concrete is used to produce load bearing wall panels, and also as the material for construction of floating marine structures. One of the main problems associated with the use of conventional light weight aggregates produced from clay, slate and shale in concrete is that these porous aggregates absorb very large amount of the water mixed in concrete. This is affecting the performance of the concrete, apart from the fact that it is difficult to maintain specific water content during the casting. Also, this absorption of water by the aggregates will means that the additional water will be required to maintain the slump at acceptable levels. These increased water contents requires higher cement contents, even without any benefit. Production of lightweight clay bricks and blocks is possible by using combustible additives in appropriate amounts and particle sizes which also increases the thermal insulation property. And the material used for this purpose is 'Polystyrene'. Polystyrene beads are stable, low density foam, which consists of 98% of air and 2% of EPS material. It has closed structure. It has good impact resistance. Each particle, which is dissipated during firing process and leaves behind a cavity, that can improve thermal insulation properties of the brick. Polystyrene foam is, therefore, used as a pore forming material in the brick body for reducing thermal conductivity and also density of brick which leads to mass reduction of building and improving its resistance to earthquake forces.

### 1.1 MATERIALS USED

A. Following materials are used

1. Sand: Locally available river sand is used as fine aggregate. Sieve analysis, Specific gravity and water absorption test were carried in the laboratory. The sieve analysis of sand leads us to that it comes under Zone II category. The test results of specific gravity fineness modulus and water absorption are shown in table 1.

| S. No. | Test | Result |
|---|---|---|
| 1. | Specific gravity | 2.62 |
| 2. | Fineness Modulus | 2.64 |
| 3. | Water Absorption | 0.5% |

2. Polystyrene balls: Polystyrene balls are brought from a wholesale retailer at Madurai, Tamil Nadu. Properties of Polystyrene balls are shown in table 2.

**Table-2:** Properties of Polystyrene balls

| *S.No.* | Properties | Result |
|---|---|---|
| 1. | Size | 1 mm to 5 mm |
| 2. | Weight (Bulk Density) | 9.5 kg/$m^3$ |
| 3. | Specific Gravity | 0.011 |

3. Water*:* Potable water available in the laboratory was used. The water was free from organic impurities and its PH value was 6.5.

**1.2 EXPERIMENTAL PROCEDURE**

A. Material procurement and preparation of clay:

The clay is mined and stored in the open space. And it is tempered properly and for conventional bricks only clay is used and for polystyrene bricks along with clay polystyrene are mixed by three different percentages. The ingredients clay and polystyrene balls were mixed thoroughly. Mixing was done within 4-5 minutes.

**Table-3:** Quantities of materials for 1 brick

| Material Samples | clay | Polystyrene balls |
|---|---|---|
| Conventional brick | 2600 | 0 |
| 5% brick | 2470 | 130 |
| 10% brick | 2340 | 260 |
| 15% brick | 2210 | 390 |

B. Moulding:

Brick moulds of size (230x110x70) mm were oiled and kept ready. In this process the mixture is taken and slapped into the mould The mould filled with the wet mix is vibrated by using vibrating table for 30 seconds. And the mould was removed and the mixture was left for drying process.

C. Drying:

In this process the bricks are arranged in aherring bone pattern and kept in sunlight for 3 – 4 days.

D. Firing:

The green bricks are arranged in kiln and insulation is provided with a mud pack. Fire holes are left to ignite the kiln and later sealed to keep the heat inside.

B. Curing:

Bricks were kept completely immersed in water and cured for the periods of 7 and 21 days.

**2. TEST AND RESULTS**

After curing, the bricks are weighed after completely drying. The water absorption and compressive strength tests were performed on the bricks.

A. Weight Analysis

The bricks are weighed after completely drying. The weight of light weight bricks (LWB1, LWB2, LWB3, and LWB4) are weighed and compared to the weight of burnt clay brick. The weight reduction is carried out by keeping the weight of burnt clay brick as a reference. The results of weight reduction are given in table 4

**Table-4:** Weight Analysis

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| Samples | Weight per brick (kg) | Weight reduction (%) |
|---|---|---|
| Conventional brick | 2.94 | 0.0 |
| LWB1 (5%) | 2.87 | 2.38 |
| LWB2 (10%) | 2.68 | 8.84 |
| LWB3(15%) | 2.51 | 14.9 |

B. Water Absorption Test

The bricks were tested in accordance with the procedure laid down in IS 3495 (Part 2). Water absorption test results of burnt clay brick and light weight brick are shown in table 5. And column chart of water absorption value is shown in Fig 1.

**Table-5:** Water absorption percentages

| Samples | Water absorption % |
|---|---|
| Conventional brick | 10.06% |
| LWB1 (5%) | 10.05% |
| LWB2 (10%) | 10.41% |
| LWB3 (15%) | 12.09% |

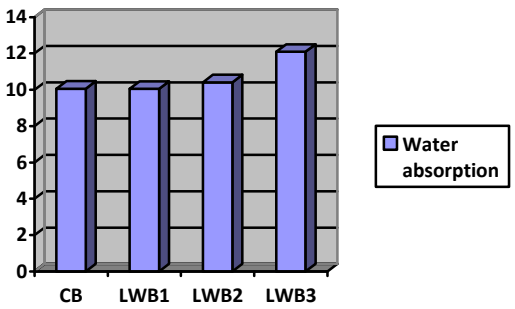


**Fig -1**: Water absorption test results of bricks at different mixing percentages

C. Compressive strength:

The compressive strength is carried out according to procedure confirming to IS3495 (Part 1):1976. In the universal testing machine the brick was placed centrally on the bottom plate. Then without any movement the upper plate of the universal testing machine was lowered down up to the brick was hold tightly. Then at a uniform rate the load was applied. The results of compressive strength are given in table8. And the variation in compressive strength is shown in the figure 2.

**Table-8:** Compressive Strength

| Sample | 7 days | 21 days |
|---|---|---|
| CB | 5.71 | 8.91 |
| LWB1 | 5.70 | 8.50 |
| LWB2 | 3.85 | 5.5 |
| LWB3 | 3.5 | 5.1 |

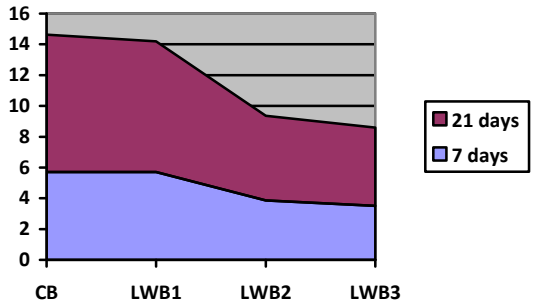


**Fig -2**: Compressive strength test results of bricks at different curing stages

## 3. CONCLUSIONS

The following conclusions were drawn from the experimental work;

*A.* Polystyrene bricks give good workability and could easily be compacted and finished.

*B.* The water absorption of Polystyrene bricks are found to be less than burnt clay bricks, which is a good sign, as bricks should posses less water absorption.

*C.* The sample LWB1 (5.70N/mm$^2$) has possessed equivalent strength as burnt caly brick (FAB = 5.71N/mm$^2$), which come under 2$^{nd}$ class brick (7N/mm$^2$) category. And other light weight sample (LWB2, LWB3, and LWB4) shows a higher result than a third class brick (i.e. higher than 3.5N/mm$^2$).

*D.* Initial finding have shown that the lightweight bricks using Polystyrene has a desirable strength to be an alternative construction material for the construction of wall.

*E.* The strength of light weight bricks using Polystyrene beads are low for lower density mixture. This resulted due to increase of beads throughout the sample caused by the Air entraining admixture.

*F.* Light weight bricks using Polystyrene balls reduces the dead load of the building which gives better stability in seismic situations.

*G.* Also concluded that designed mix proportions are useful in cladding panels and tilt up panels.

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