Experimental Study on the Effect of Liquid Foam on Light Weight Bricks

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***Abstract*— Brick is one of the oldest building materials. A brick is a block or a single unit of a ceramic used in masonry construction. On the basis of field practice, bricks are classified into four classes. Fly ash bricks refer to those bricks which use fly ash, lime or cement as main raw materials, adding moderate gypsum and aggregates, after mixture preparation, pressed in molding, and then through high temperature or normal pressure curing or natural curing methods into beings. Light weight brick are mainly used for load bearing structure and framed structure. It's another alternative for red brick and fly ash bricks. In light weight brick, it possess water absorption is less compare to conventional and fly ash brick, high thermal insulation, high compressive strength, less weight, accurate shape, environmental friendly.**

The objective of the study is to reduce the weight using liquid foam and to get high compressive strength. Class F fly ash is used as binding material with some additives. The unique property of gas-liquid foams having very high specific surface area is exploited in the chemical processes of froth flotation and foam fractionation. The brick mixture included only Ordinary Portland cement as the binder material. Sludge bricks of size 228.6x114.5x76.2mm were cast with and without of fly ash. A comparison is made between conventional bricks, fly ash bricks and light weight bricks using foam. Light Weight Brick reduces the dead load weight of any building resulting in reduction of reinforced steel used in construction and due to its light weight and bigger in size, the cost of labor, mortar, plaster reduces resulting in major saving in cost of construction.

***Index Terms*— Conventional brick, fly ash, Cement, liquid foam, Compressive strength, water absorption.**

I. INTRODUCTION

Brick is one of the oldest building materials. It is cheap, durable and easy to handle and work with. Fly ash bricks refer to those bricks which use fly ash, lime or cement as main raw materials, adding moderate gypsum and aggregates, after mixture preparation, pressed in moulding, and then through high temperature or normal pressure curing or natural curing methods into beings. Light weight brick are mainly used for load bearing structure and framed structure. It's another alternative for red brick and fly ash bricks. In light weight brick, it possess water absorption is less compare to conventional and fly ash brick, high thermal insulation, high compressive strength, less weight, accurate shape, environmental friendly. The natural waste material creates problem of disposed by spreading on land or by land filling. So, the waste materials are used in manufacturing the brick. Vegetable oil foam is used to reduce the weight of brick and increase the strength. To reduce the total cost of construction by controlling the weight of structures light weight bricks are made.

II. OBJECTIVE OF THIS STUDY

The ultimate aim of this work is to study the possibility of using vegetable oil foam as the admixture used in brick. Light weight brick is made to reduce the weight using liquid foam and to get high compressive strength.

III. LITERATURE REVIEW

The literatures reviewed indicate the mix design, strength characteristics for light weight bricks.

Bricks are a widely used construction and building material around the world. These bricks may be prepared from natural waste material which comprises of orange peels and coconut waste. From experimentation it is observed that the bricks prepared is light weight, shock absorbing and meets compressive strength requirements of ASTM C 67-03a and BIS. [1]

The heavy weight bricks accounts for the great mass of construction and thus causes more vulnerability against earthquake forces. The work carried out, tried to reduce the density of the bricks, as well as improve thermal insulation properties. Polystyrene foam is one of the substances that wereadded to the raw materials of bricks, as a pore-forming material. The effect of PSF type and its content in the mix, also the effect of firing process temperature of the bricks on density, Water absorption and compressive strength, are investigated and discussed in this paper. [2]

The insulation properties of lightweight bricks were prepared by mixing some organic materials in the clay. Organic materials in bricks evaporate during burning, resulting small pores in bricks, causing reduction in weight and

improve insulation of bricks. Six Different samples of bricks are made by replacing 5%, 10%&15% of clay proportion with Saw dust and Wheat husk, to make the bricks light and more insulated than normal brick. Out of six specimens Wheat Husk 5% gave best results satisfying all the standards and having less weight and greater insulation than the normal brick. [3] Resource recovery and utilization of industrial by-product materials for making construction material gained significant attention across the world. Recycle paper mill residue (RPMR) and rice husk ash (RHA) were utilized to improve the properties of bricks. A homogeneous mixture of RPMR-RHA-cement was prepared with varying amount of RHA (10-0% by weight) and RPMR (70-80% by weight) and tested in accordance with the IS codes. The results indicated that RPMR bricks prepared from RPMR-RHA-cement combination are light weight and meet compressive strength requirements of IS 1077-1992. [4]

IV. MATERIALS USED

Preparation of additives

Class F Fly ash was used as binding material with some additives.

Preparation of liquid foam

Foam is made up of vegetable wastes.

Cement

Ordinary Portland cement (53-grade) confirming to IS: 12269 were used.

Table 1 : Properties of cement

Properties	Values
Cement	OPC 53 grade
specific gravity	3.15
Fineness	4%
Consistency	30.5%
Bulk density	1.506g/cc
Specific surface area	310m2/Kg
Fineness modulus	3.5
Initial setting time	1Hr 5Min
Final setting time	3Hr 55Min

Fly Ash

The physical and chemical properties are tested according to the standard specifications.

Table 2: Physical properties of Fly Ash

Propert		Result
Specific Gravity		***2.227***
Fineness	Retained on 45µ Sieve	9%

Table 3: Chemical properties of Fly Ash

Chemical Compound	Percentage Present
SiO_2	55.5
Al_2O_3	31.3
Fe_2O_3	6.4
CaO	1.02
MgO	0.21
Alkalis equivalent	Nil
TiO_2	2.7
SO_3	0.44
Loss on Ignition	0.74

Fig. 1 Fly Ash

Lime

Limestone is calcareous sedimentary rocks formed at the bottom of lakes and seas with the accumulation of shells, bones and other calcium rich goods. It is composed of calcite ($CaCO_3$).

Fig. 2 Lime Powder

Table 4: Properties of Lime

Properties	**Values**
Molecular formula	$Ca(OH)_2$
Molar mass	74.093 g/mol
Appearance	white powder
Odour	Odourless
Density	2.211 g/cm^3, solid
Melting point	580 °C (loses water)
Solubility in water	0.189 g/100 mL (0 °C) 0.173 g/100 mL (20 °C) 0.066 g/100 mL (100 °C)
Solubility product, Ksp	4.68×10^{-6}
Acidity (p Ka)	12.4
Basicity (p Kb)	2.37
Solubility	Soluble in glycerol and acids. Insoluble in alcohol.

Gypsum

Gypsum is a soft sulphate mineral composed of calcium sulfate di-hydrate, with the chemical formula $CaSO_4{\cdot}2H_2O$. It forms as an evaporate mineral and as a hydration product of anhydrite.

Fig. 3 Gypsum

Foam

Construction foam is a quick and effective construction material for defending against mobs. Workers are able to break the foam before it hardens in no time. However, broken foam cannot be harvested.

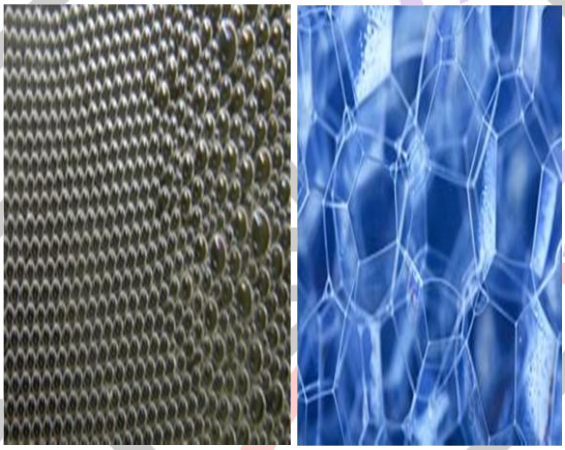

Fig. 4 Variety of foam

V. EXPERIMENTAL SETUP

Being a multi-scale system involving many phenomena, and a versatile medium, foam can be studied using many different techniques. Considering the different scales, experimental techniques are diffraction ones, mainly light scattering techniques (DWS, see below, static and dynamic light scattering, X rays and neutron scattering) at sub- micrometer scales, or microscopic ones. Considering the system as continuous, its bulk properties can be characterized by light transmittance but also conduct-metric. The organization between bubbles has been studied numerically using sequential attempts of evolution of the minimum surface energy either at random (Pott's model) or deterministic way (surface evolver). The evolution with time, i.e. the dynamics, can be simulated using these models, but also the bubble model (Durian) which considers the motion of individual bubbles.

Mix Design

The brick mixture included only Ordinary Portland Cement as the binder material. Mixture proportions are summarized as follows.

Table 5: Mix Proportion

Description	Fly Ash	Gypsum	Lime	Cement	Crushing Powder	Liquid Foam
Fly Ash Brick	1.4	0.21	0.49	0.150	1.4	NIL
Light Weight Brick type 1	1.4	0.21	0.49	-	-	YES
Light Weight Brick type 2	0.9	0.21	0.49	0.6	-	YES

VI.EXPERIMENTAL ANALAYSIS

Mechanical Properties of Brick

Compressive strength

Sludge bricks of size 228.6x114.5x76.2mm were cast with and without of fly ash. After casting using machine it is taken away and subjected to water curing after 24 hours. After 7 days, 14 days and 28 days of curing bricks were taken and allowed to dry and tested in compressive strength testing machine. The specimens were tested according to the IS 516-1964 the rate of loading was about 14 N/mm² per minute and the ultimate load was noted.

Fig. 6 Compressive Strength Test

Table 6: Compressive Strength of Fly AshBricks

Fly Ash Bricks	Compressive Strength in 7 days (N/mm^2)	Compressive Strength in 14 days (N/mm^2)	Compressive Strength in 21 days (N/mm^2)
Brick 1	5.20	8.20	11.20
Brick 2	4.90	7.40	10.45
Brick 3	6.20	9.30	12.45
Brick 4	6.40	9.65	12.50
Brick 5	6.25	9.85	12.25

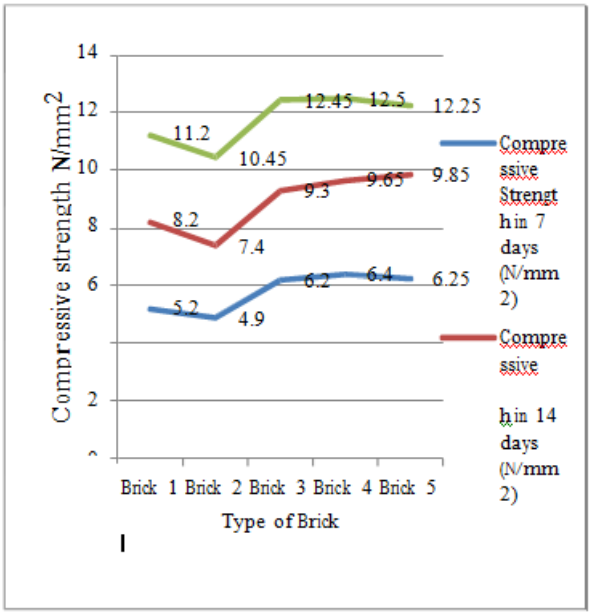

Fig. 7 Compressive Strength of Fly Ash Bricks

Table 7: Compressive Strength of Light Weight Bricks Type- 1

Light weight bricks Type-1	Compressive Strength in 7 days (N/mm^2)	Compressive Strength in 14 days (N/mm^2)	Compressive Strength in 21 days (N/mm^2)
Brick 1	2.20	4.80	6.45
Brick 2	2.50	4.45	6.80
Brick 3	2.25	4.50	6.90
Brick 4	2.45	4.85	6.30
Brick 5	2.55	4.55	6.45

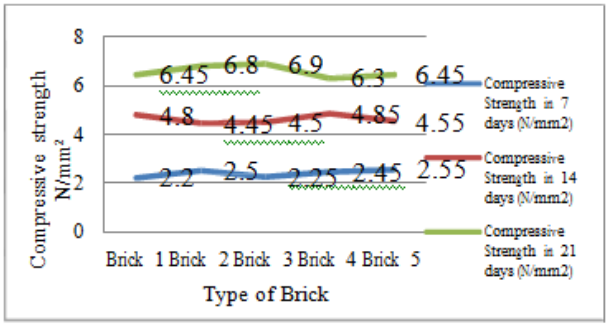

Fig. 8 Compressive Strength of Light Weight Brick Type – I

Table 8: Compressive Strength of Light Weight Bricks Type- 2

Light weight bricks Type-2	Compressive Strength in 7 days (N/mm^2)	Compressive Strength in 14 days (N/mm^2)	Compressive Strength in 21 days (N/mm^2)
Brick 1	2.90	5.40	7.45
Brick 2	2.85	5.45	7.80
Brick 3	2.80	5.50	7.90
Brick 4	2.90	5.85	7.30
Brick 5	2.95	5.55	7.45

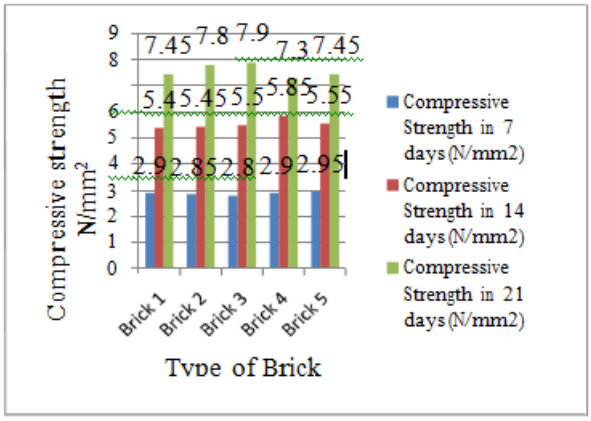

Fig. 9 Compressive Strength of Light Weight Brick Type – II

Water absorption

Dry the specimen in a ventilated oven at a temperature of 105 °C to 115°C till it attains substantially constant mass. Cool the specimen to room temperature and obtain its weight (M_1) specimen too warm to touch shall not be used for this purpose. Immerse completely dried specimen in clean water at a temperature of 27+2°C for 24 hours. Remove the specimen and wipe out any traces of water with damp cloth and weigh the specimen after it has been removed from water (M_2).The water absorption test is carried out for the different types of bricks. The bricks considered were conventional bricks, fly ash bricks, light weight bricks of type I and type II.

Fig. 10 Water Absorption Test

Table 9: Water Absorption Test for Conventional bricks

S No	Weight Before Absorptio	Weight After Absorptio	% Of Water Absorption
1	3.160	3.580	13.29
2	3.000	3.460	15.33
3	3.180	3.610	13.52
4	3.060	3.480	13.72
5	3.210	3.640	13.39

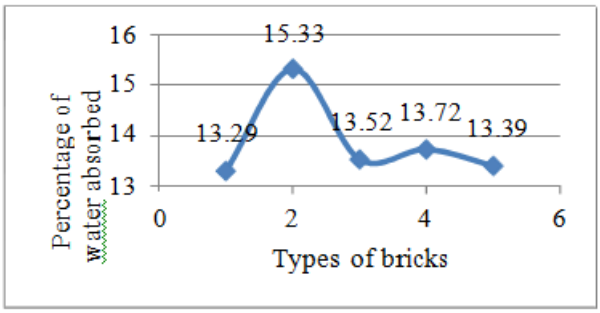

Fig. 11 Water Absorption Test for Conventional bricks

Table 12: Water Absorption Test for Light weight bricks Type-2

S No	Weight Before Absorptio	Weight After Absorptio	% Of Water Absorption
1	1.960	2.140	9.18
2	2.010	2.160	7.46
3	2.060	2.210	7.28
4	1.980	2.180	9.21
5	1.990	2.110	8.10

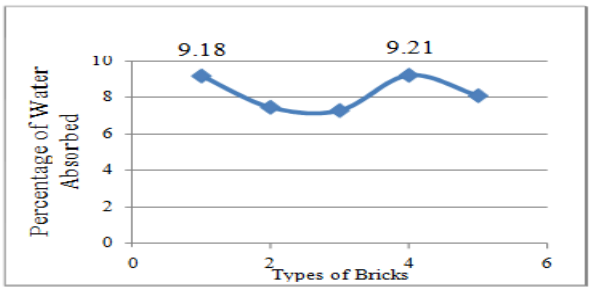

Fig. 14 Water Absorption Test for Light weight bricks Type-2

Table 13: Comparison of Bricks

S N O	Types of Bricks	Water Absorption Test	Compressive Strength Test	Average Weight of Brick
1	Conventional Brick	13.50	7.20	3.20
2	Fly AshBrick	12.75	11.77	3.50

3	Light Weight Brick Type 1	5.20	6.58	1.70
4	Light Weight Brick Type 2	7.50	7.58	1.90

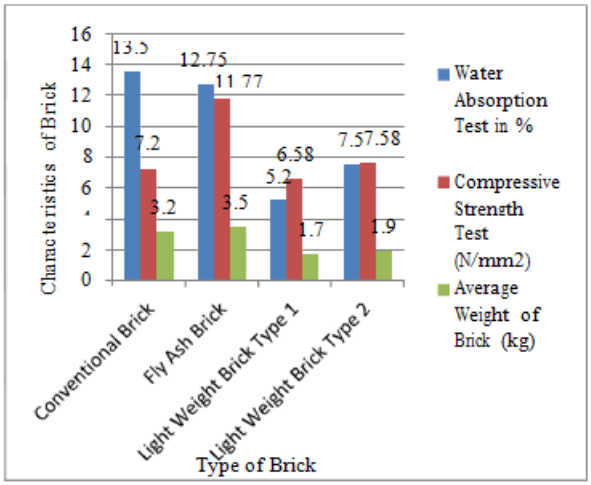

Fig. 15 Comparison of Bricks

VII. CONCLUSION

He clay brick production industry is a major source of air pollution in developing countries. The process of manufacturing clay bricks also requires high energy to burn due to the emission of CO2 gas in the process. By making the brick by using vegetable foam by adding gypsum, fly ash, lime powder, cement, the result we obtained finally in this project is nominal for the economical consideration comparative to other conventional and fly ash bricks. But the compressive strength of the brick we made gives an average result comparative to the fly ash brick. Whereas in terms of conventional bricks the obtained result gives similar compressive strength. Light Weight Brick has 50% lesser weight than the Fly Ash and Conventional Bricks; it has Water Absorption capacity of 6%.

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