

**AN EXPERIMENTAL INVESTIGATION ON LIGHT WEIGHT FOAM
CEMENT BLOCKS WITH QUARRYDUST REPLACEMENT
FOR FINE AGGREGATE.**Dr. B.Madhusudana Reddy¹, B.Veni²¹Assistant Professor

Department of Civil Engineering

Sri Venkateswara University College of Engineering, Tirupati, Andhra Pradesh, India.

²PG Student

Department of Civil Engineering

Sri Venkateswara University College of Engineering, Tirupati, Andhra Pradesh, India.

Abstract - Foamed concrete is a versatile material which consists primarily of a cement based mortar mixed with at least 20-25% volume of air. It is non-load bearing structural element which has lower strength than conventional concrete. In the present investigation, an experimental study is carried on the influence of varying densities of foam in the quarry dust based foam concrete. The range of densities investigated are 800kg/m³, 1000kg/m³, 1200 kg/m³, 1400 kg/m³, 1600 kg/m³, 1800 kg/m³. The density of concrete is varied by using synthetic foam called sodium lauryl sulphate, for 30 liters of water 1 liter of foam is used separately and the same is introduced into the fresh concrete during its mixing by controlling its concentration to its desired density of concrete is achieved. The results are discussed elaborately with respect to compressive strength, split tensile strength, flexural strength and water absorption. The results indicate that the optimum compressive strength, split tensile strength, flexural strength is arrived at 1200 kg/m³ density.

Keywords: Foaming agent, Quarry dust, Fine aggregate replacement, Foam Concrete, Compressive Strength, Flexural Strength, Split Tensile Strength and Water absorption.

1. INTRODUCTION

Concrete is the second most widely consumable substance on earth, after water. In concrete construction, self-weight represents a very large proportion of the total load on the structure; hence there are clearly considerable advantages in reducing the density of concrete by using Light Weight Concrete (LWC). The chief of these are the use of smaller sections and the corresponding reduction in the size. Furthermore, with lighter concrete the form work needs to withstand a lower pressure than would be the case with ordinary concrete, and also the total weight of materials to be handled is reduced with a consequent increase in productivity. LWC also gives better thermal insulation than ordinary concrete. Foam concrete also known as foamed concrete, foamcrete, cellular lightweight concrete or reduced density concrete, is defined as a cement based slurry, with minimum of 20% (per volume) foam entrained into the plastic mortar, this differentiates foam concrete from (a) Gas or aerated concrete, where bubbles are chemically formed through reaction of aluminum powder with calcium hydroxide and other alkalis released by cement hydration and (b) Air entrained concrete, which has much lower volume of entrained air. Mostly no coarse aggregate is used for production of foam concrete. The correct term would be called as mortar instead of concrete. Sometimes it may be called as Foamed Cement or foam Cement because of mixture of only cement and foam without any fine aggregate. From the literature review, it was identified that many studies have been carried out on light weight concrete considering the future possibilities. It was noted that very few studies have been conducted on Lightweight Foamed Concrete (LFC) which has a great potential in future. Based on the review conducted, it was observed that the majority of investigations were limited to evaluating the foam concrete properties, rather than focusing on characteristics of foam itself.

The following advantages of foam concrete

- Rapid and relatively simple construction.
- Economical in terms of transportation as well as reduction in manpower.
- Significant reduction of overall weight results in saving structural frames, footing or piles.
- Most of lightweight concrete have better nailing and sawing properties than heavier and stronger conventional concrete.

2.OBJECTIVE

The practical range of densities of lightweight concrete is between 8.00 and 18.50 kN/m³. One such LWC is foamed concrete. Foam concrete is a very fluid, lightweight cellular concrete fill material, produced by blending a cement paste (the slurry or mortar), with a separately manufactured, pre-formed foam. The density of foam concrete is determined by the ratio of foam to slurry and densities range typically between 300 and 1800 kg/m³.

The objective of the present research work is to find the influence of quarry based foam concrete with varying densities of foam (800 kg/m³, 1000 kg/m³,1200 kg/m³,1400 kg/m³,1600 kg/m³,1800 kg/m³) .

The objectives of the work is:

- a. To determine the optimum concentration of foam in foam concrete.
- b. To investigate the optimum percentage of foam to be added to mortar so as to reduce density with desired strength.
- c. To find compressive strength,split tensile strength and flexural strength of concrete with the varying densities.
- d. To find replacement with quarry dust which is again a waste product makes the concrete less dense and enhances the strength.

3.EXPERIMENTAL PROGRAMME AND PROPERTIES OF INGREDIENTS

3.1 Properties of Materials

3.1.1 Cement

In the present investigation Ordinary Portland cement (OPC) of 53 Grade confirming to IS specifications was used. The physical properties of cement are shown in Table 1.

Table 1. Physical Properties of Cement

S.No	Properties	Values
1	Fineness	2.0%
2	Normal consistency	31%
3	Specific gravity	3.12
4	Initial setting time	95 minutes
5	Final setting time	260minutes

3.1.2 Quarry dust

The quarry dust used in the investigation is obtained from the quarry at Chandragiri near Tirupati Andhra Pradesh. Locally available quarry dust confirming to IS specifications was used as the fine aggregate in the concrete preparation. The properties of quarry dust are shown in Table 2.

Table 2. Physical properties of Quarry dust

S.No	Property	Result
1	Specific Gravity	2.52
2	Fineness modulus	3.2
3	Grading of sand	Zone-1
4	Density of Quarry Dust	1653kg/m ³

3.1.3 Foaming Agent (sodium lauryl sulphate)

Foaming agent used in the study was manufactured by Acuro Organics Ltd, New Delhi Bee Chemicals. Specifications of foaming agent as given by the supplier are given in the following table 3.

Table 3 : Properties of Sodium lauryl sulphate

Parameter	Values
Physical state	White colour
pH	9 - 10
Specific gravity	1.05
stability	Stable under normal conditions

3.1.4 Water

The water used for casting and curing of concrete test specimens was free from acids, organic matter, suspended solids and other impurities are much lower than the standard permissible limits.

3.2 EXPERIMENTAL PROGRAMME

Concrete test specimens consist of 150 mm × 150 mm × 150 mm cubes, cylinders of 150 mm diameter × 300 mm height and prisms of 100 mm × 100 mm × 500 mm. Concrete cubes were tested at different curing periods (3, 7, 28, 56 and 90 days) of curing to get the compressive strength. Cylindrical specimens were also tested at the age of 28 days to obtain the split tensile strength and the modulus of elasticity of concrete. The prisms were tested at the age of 28 days to obtain the flexural strength of concrete. The rate of loading is as per the Indian Standards specifications.

Table 4 .Preparation of Specimen

S.No	Type of test	Sample	No. of Samples					Total
			3 days	7 days	28 days	56 days	90 Days	
1	Compressive Strength	Cubes	21	21	21	21	21	105
2	Split Tensile Strength	Cylinders	---	---	21	---	---	21
3	Flexure Strength	Prisms	---	---	21	---	---	21

4.RESULTS AND DISCUSSION

4.1 Compressive Strength

The variation of the cube compressive strength of size 150x150x150 mm with different densities of foam concrete is shown in Fig.1 and strength at different ages are shown in fig2. The cube compressive strength indicates the average of three test results for 3,7,28,56 and 90 days. The results shows that with increase of density the strength is increasing. Compare to the present results at 1200 kg/m³ the strength is 12.36 MPa. For 3 days the compressive strength for the 800kg/m³ ,1000 kg/m³,1200kg/m³ densities of foam concrete the strength is more over the same with small variations .For 90 days at 800kg/m³ and 1000kg/m³ the strengths are nearly equal again at 1600kg/m³ and 1800kg/m³ the strengths are nearly equal. With out using any foam the strength at 90 days is 30.4 MPa. At no foam condition the strength at 56 days and 90 days is nearly equal i.e, 29.3MPa,30.4MPa.

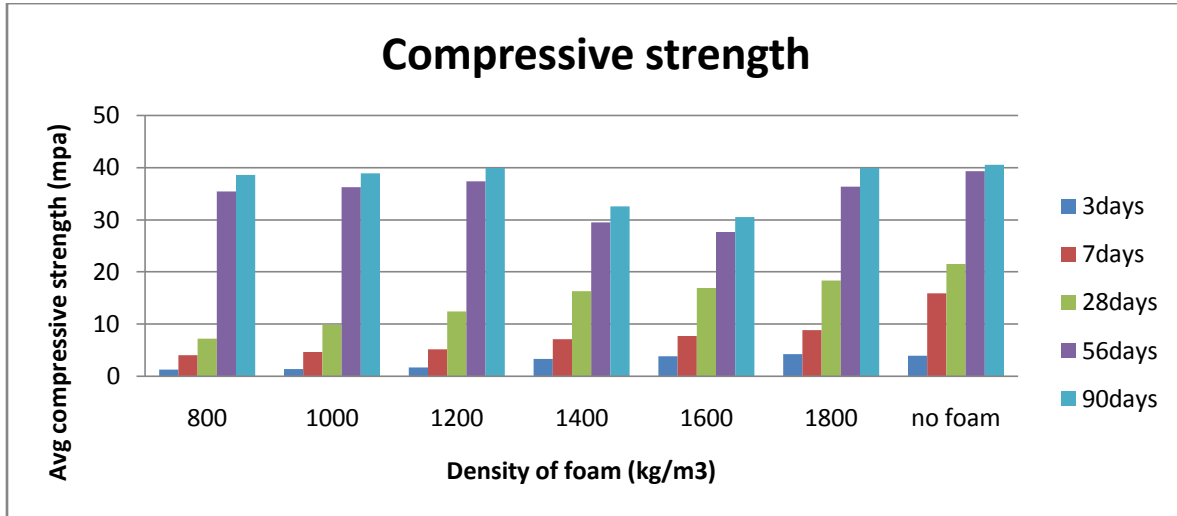


Fig1: Compressive Strength of foam concrete with different densities of foam

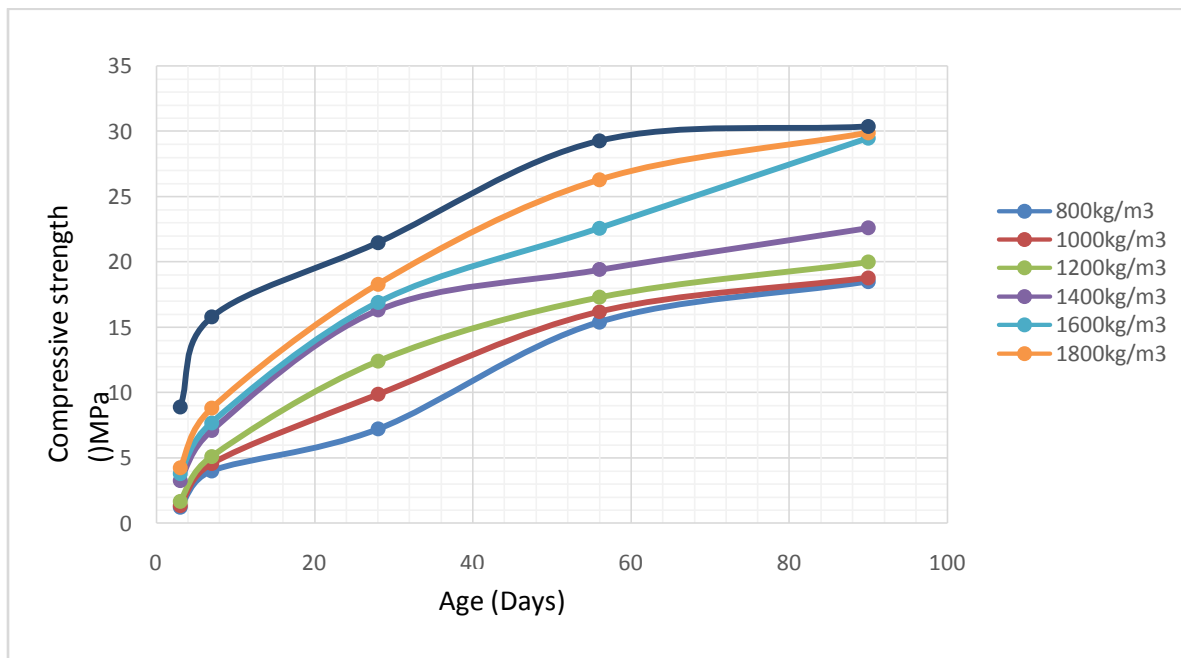


Fig2: Compressive Strength of foam concrete at different ages.

Fig 1 and fig 2 show the variations in compressive strength with respect to density and age respectively

4.2 Split Tensile Strength:

Cylinders of 150 mm diameter and 300 mm height with varying densities of foam were casted and tested the strength at 28 days for its split tensile strength is shown in fig .2. Compare to the present results at 1200 kg/m³ the split strength is 1.75 MPa..At 1400kg/m³ and 1600kg/m³ the split tensile strength is nearly equal i.e,2.18MPa and 2.23 MPa.

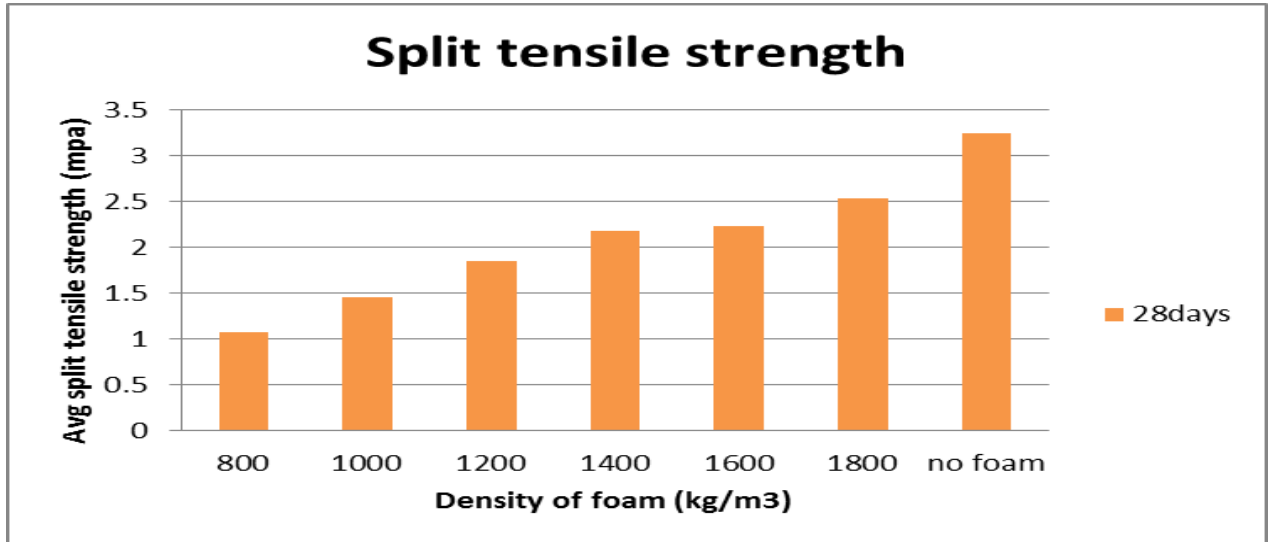


Fig 2: Split Tensile Strength of foam concrete with different densities of foam

Fig 1 and fig 2 show the variations in compressive strength with respect to density and age respectively

4.3 Flexural Strength:

The variation of flexural strength with different densities of foam of Concrete Beams of size 500 mm Length and 100mm × 100 mm cross section are cast and the results are shown in fig.3. Compare to the present results at 1200 kg/m³ the Flexure strength is 2.5MPa which is more than the strength of brick.

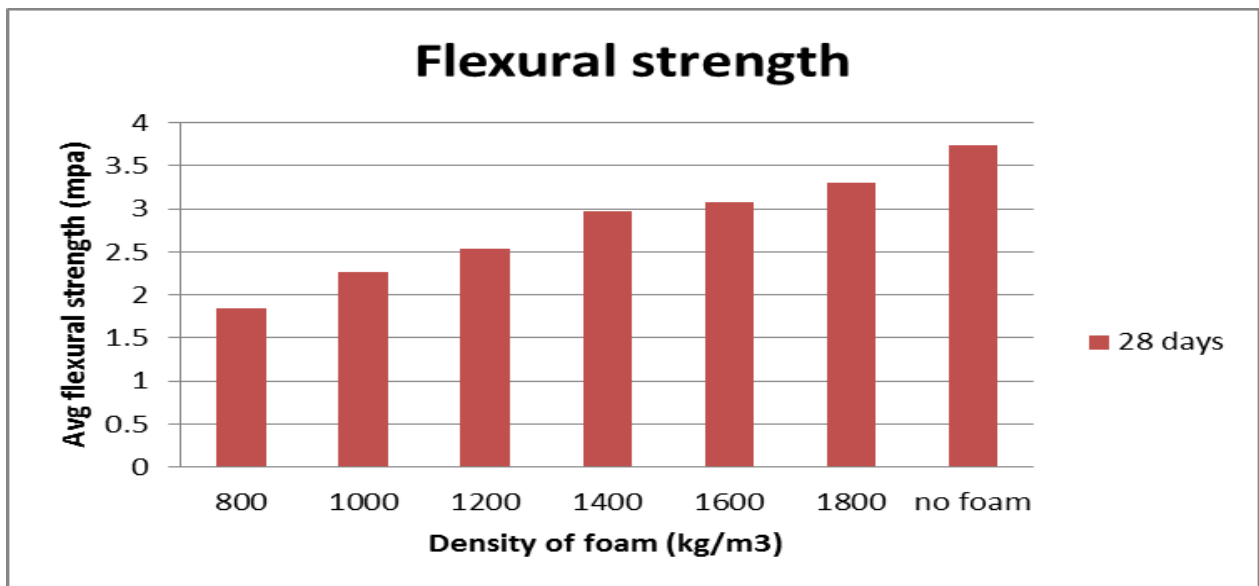


Fig 3: Flexural strength of foam concrete with different densities of foam

4.4 Water absorption:

With increasing of density, the water absorption is decreasing. At 800kg/m³, 1000kg/m³, 1200kg/m³ the water absorption is nearly the same. From 1600 kg/m³ and above the water absorption is less than 10% is observed. However, at the optimum mix of 1200kg/m³, the water absorption is 11.6%. Water absorption of almost 12% is observed for 800kg/m³ density.

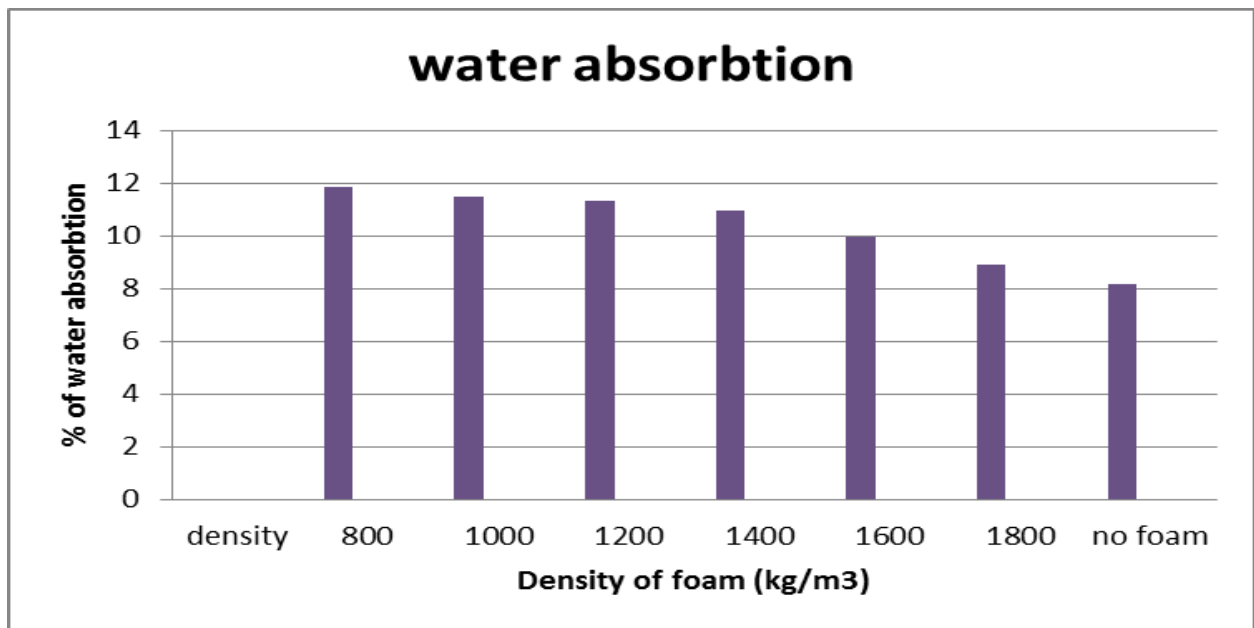


Fig 4: Water absorption of foam concrete with different densities of foam

5. CONCLUSIONS

- With increasing of density, the strength goes on increasing.
- Using the test results, it can be concluded that the percentage of cement content will be reduced to half by using quarry dust so that CO₂ emissions from the cement can be reduced.
- As no coarse aggregate is used it can be used as precast in-situ elements.
- From the results of compressive strength and water absorption it can be noticed that 1200 kg/m³ is the optimum density.
- Brick has compressive strength of 3 to 7 MPa at 1900 kg/m³, compared to the present results at 1200 kg/m³ the strength is 12.36 MPa which is 50% more than that.
- The water absorption for good quality is 15% but in case of foam concrete at 1200 kg/m³ the water absorption is 11.37%.
- By selecting 1200 kg/m³ as optimum density we can reduce the density by 40%.

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