|| Volume 2 ||Issue 12 ||JULY 2017||ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH
AND ENGINEERING TRENDS

Addition Of Supplementary Cementitious Materials Enhances The Strength Properties of Foam Concrete

Supriya Siddharth More[1], Dr.Geetha K Jayaraj[2]
Shivajirao. S. Jondhle College of Engineering and Technology, Asangaon, Thane India[1 2]

***Abstract*— Foam Concrete is a type of versatile light weight concrete where the density varies from 400 kg/ m3 – 1900 kg/ m3, which is very less than when compared with normal concrete. Foam concrete mainly challenges the strength parameter, as the density of concrete is very less; hence the strength is also less. This study focuses to increase the strength parameter of Foam concrete by using HVFA mixes along with Alcofine to achieve the strength with low densities. It is found that when Alcofine is added along with HVFA mixes the strength increment is more as compared with HVFA mixes without Alcofine addition**

Keywords – HVFA – High Volume Flyash mix

I INTRODUCTION

Foam Concrete is a type of versatile light weight concrete where the density varies from 400 kg/ m3 – 1900 kg/ m3, which is very less than when compared with normal concrete. The Foam concrete is used for various applications thermal insulation, formation of light weight concrete blocks, ground stabilization works, void filling in structures etc. Foamed concrete is formed by adding air-voids where the air is entrapped in mortar by using foaming agent. Production of stable foam is very important to maintain the density and this affected by various factors , type of foaming agent, method of foam preparation, pressure at which the foam is generated from the foam generation machine. In today's world of Sustainable concrete solution it becomes necessary for use of High Volume flyash mixes. This study focuses to increase the strength parameter of Foam concrete by using HVFA mixes along with Alcofine to achieve the strength with low densities. It is found that when Alcofine is added along with HVFA mixes the strength increment is more as compared with HVFA mixes without Alcofine addition

II CHARACTERISTICS OF FOAMED CONCRETE

A. Light weight:

The density of foamed concrete is low than ordinary concrete about 50%-80%, and its apparent density is usually maintained at 300-1200kg/m³. Because of its low density and small load, the weight of today's construction can reduce weight about 25% whether its application on the inside(outside) wall or column structure, sometimes even reach 30%-40% of the overall quality of the structure.

B. Good heat-insulating property:

Foamed concrete is a kind of heat preservation and insulation material which is mainly used in building wall and roof, and has high efficiency of energy saving. Its interior has many uniform pores which control the air in a large part and prevent from the cold and the heat exchanging. The thermal conductivity of the commonly used foam concrete is about 0.1W (K /m), which is 7 times less than that of the clay brick and 14 times less than that of the ordinary cement concrete.

C. High fire resistance and sound insulation

Foamed concrete is mainly composed of cement paste, aggregate, other inorganic materials (which don't have the chemical characteristics of spontaneous combustion) and dispersed pores, so it has the good fire resistance. At the same time, because of the existence of many closed pores, the foam concrete has a good sound insulation performance.

D. Good seismic performance

The foamed concrete is of light weight, small density and small elastic modulus. It is a kind of porous structure with many closed bubbles. The foam concrete is a kind of building material with excellent seismic performance when it is subjected to the action of earthquake wave, which can diffuse and absorb the impact load.

E. Other performance

Because of the porous structure, foamed concrete has good frost-resisting property and corrosion resistance. The foam comes from foaming machine in the stirring process can play a role in reducing the water and lubricating. The foam concrete can use large quantities of industrial waste and other materials, which is not only conducive to the environmental protection, but also reduce the production cost [9]

III CONSITUENTS OF FOAM CONCRETE

A. Cement -Cement is the main binder for foam concrete. Foam concrete can be produced with all types of cements and is less affected with changes in cement types. However, OPC 53 Grade cement is generally preferred in the production process.

B. Flyash - Fly ash has been widely used in construction practices. A good fly ash should have high fineness, low carbon content and good reactivity which would enhance the technical advantage of the properties of foamed concrete.

C. Alcofine - Alcofine is a new generation, micro fine material of particle size much finer than other hydraulic materials like cement, fly ash, silica etc. being manufactured in India. Alcofine has unique characteristics to enhance 'performance of concrete' in fresh and hardened stages due to its optimized particle size distribution. It can be used as practical substitute for Silica Fume as it has optimum particle size distribution not too coarse, not too finer either per the results obtained by Counto Micro fine products Pvt. Ltd

D. Water -Water used in the manufacture of foam concrete is potable water free from suspended solids and other wastes

E. Foaming Agent - The surfactant is a key factor in the types of bubbles generated. Surfactants are wetting agents that lower the interfacial tension between two liquids and also lower the surface tension of liquid, allowing easier spreading. There are extensive varieties of surfactants (foaming agent) available in the market. Surfactants are formulated to produce stable air bubbles which can resist the physical and chemical forces imposed during mixing, placing and hardening in the process of making foamed concrete. But it is very important to store all surfactants accordingly because they are inclined to deterioration at low temperatures. The surfactant solution consists of one part surfactant and between 5 to 20 parts water. But the optimum value is a function of the type of surfactant and the technique of production [8]

IV METHODOLOGY

There is no proper or exact method found for proportioning foamed concrete (i.e. mix design), but it is a specified target plastic density that becomes a prime design criterion. On the basis of target plastic density a theoretical mix design is to be formulated and site trials are undertaken and the results from the site trials are used as mix design for the foamed concrete. Various Trials were done with and without Alcofine addition in the mixes. Below is the mix design attached with HVFA mixes. As been discussed before, trial and error method was used in determining the most suitable mixture in preparing research samples.

V EXPERIMENTAL PROCEDURE

Foam concrete with HVFA mix with and without Alcofine was prepared and was tested against the fresh and hardened properties wherein the method used to determine the physical (Density) as well as a specific structural property (compressive strength) of the foamed concrete mixtures.

Table 1 Shows the Trial mix Proportions

kg/m³	Trial	Trial	Trial	Trial	Trial	Trial
Cement	175	175	235	235	295	295
Fly Ash	175	175	235	235	295	295
Foam	100	100	100	100	100	100
Water	150	150	135	135	135	135
CRF	500	482	595	571	675	645
Admixture	2.1	2.21	2.82	2.961	3.54	3.717
Alcofine	0	17.5	0	23.5	0	29.5
Target Density(kg/m³)	1100	1100	1300	1300	1500	1500

A. Composition of Foam Concrete Mixture

The foamed concrete used in this research is produced under controlled conditions from cement, fly ash, sand, water pre-formed foam and Alcofine. The cement used is 53 grade Ordinary Portland cement, locally available sand, Alcofine 1203 , fly ash (Tata) IS certified having density 860 kg/m3 , foaming agent (Gubbi Enterprise- Constro Chem India Pvt Ltd) for produce the foam and water has been used for producing foam concrete. Foam was generated by using foam generator the out-put of generator is 30-32 lit/min. for producing the foam. Foaming agent is diluted with water in a ratio of 1:20.

B. Mixing Procedure

Initially the materials were weighed and dry mixing was carried out for cement, fly ash, Alcofine and sand in the concrete mixer and then the water was added incrementally to obtain a reasonable workable mix. The mixing was carried out for one- two minute duration. The required quantity of foam was set in foam generator and then it was added to the wet mix and again the mixing was continued. Mixing for more duration after adding foam will disintegrate the foam. Then they were poured into the cube moulds of size 150x150x150 mm.

C. Curing

The 150 mm test cubes were cast in steel mould and de-moulded after ± 24 hours. As compared with the conventional concrete the curing was done for the cubes casted. Almost each trial -06 number of cubes where casted and where cured in the curing tank with a temperature of 27+_2 degree centigrade. Full time continuous curing has been done in the laboratory.

E. Compressive Strength

The cubes were crushed on on compression testing machine) which is usually used for normal concrete. Three cubes from the same mixture of foamed concrete were crushed and the average of the three results is used to define the strength of the mixture.(According to IS: 516-1959) .Where in the compressive strength was recorded to the nearest 0.1 MPa. The Cubes were tested for Compressive strength which is recorded for 7 and 28 days

VI RESULTS

The Study shows the strength of Foam concrete with and without addition of Alcofine. There is an increment in strength observed when the quantity of Alcofine increases along with the increase in the cementitious content. The results are presented in Table 2 it can be seen that the compressive strength of foamed concrete is increases with Density.

Table 2 Shows the Trial mix Proportions with strength

kg/m³	Trial	Trial	Trial	Trial	Trial	Trial
Cement	175	175	235	235	295	295
Fly Ash	175	175	235	235	295	295
Foam	100	100	100	100	100	100
Water	150	150	135	135	135	135
CRF	500	482	595	571	675	645
Admixture	2.1	2.21	2.82	2.961	3.54	3.717
Alcofine	0	17.5	0	23.5	0	29.5
Target Density(kg/m³)	1100	1100	1300	1300	1500	1500
Achieved Density(kg/m³)	1183	1210	1356	1398	1595	1603
7 days N/mm2	1.12	1.45	1.56	2.25	3.11	4.03
28 days N/mm2	2.93	3.45	3.78	4.52	6.89	9.57

VII CONCLUSION

The density is directly related with compressive strength of foam concrete. The increment of voids throughout the sample which is achieved by the foam in the mixture will give lower the density. As a result, compressive strength will decrease as there increment in the voids. Usually the criteria for structural lightweight concrete are minimum 28-day compressive strength of 17 MPa and Dry density of 1850 kg/m.The compressive strength of the trial results are less than 17 MPa, as reported in this investigation, hence it can be concluded that the prepared foam concrete mixtures cannot be used for structural purpose, but it can be used for making partition wall in buildings ,Sound insulation, ground works such as stabilization, tunnel repair works which will result in decrease in the self weight of structure because the density is very low as compared to bricked masonry work. The density of foam concrete is very low when compared with conventional concrete; therefore, the self weight of a structure built with foamed concrete would undoubtedly be reduced significantly, leading to tremendous savings in the use of reinforcement steel in the foundations and structural members. Use of foam concrete as an alternative to normal concrete in construction can decrease the building's dead load as well as the force exerted on the structure due to earthquake excitations and the resultant collapse weight of the building if it falls down. It is observed that the use of Alcofine in Foam Concrete can be greatly improves its properties also same with case of Fine aggregate in Foamed Concrete increases its density as well as strength parameter. It is generally observed that the de-moulding of high density foamed concrete is possible after 24 hours but for low density foamed concrete could not be possible, it required minimum 3 days for de-moulding period because their strength is very low and the cube shape gets damaged.

VIII FUTURE SCOPE

The foam concrete has a desirable strength and can be used as an alternative construction material for the any building system. The strength of foam concrete is very low for lower density mixture hence for non structural areas of building this can be used successfully as this reduces the dead loads on the structures. So, significant reduction of overall weight results in ultimate saving in structural frames. The Foam concrete usually is flow able mix hence requires no vibration or compaction It offers variety of advantages such as fast and settlement free construction with good heat Insulation, good freeze/thawing properties and has excellent fire resistance properties.

REFERENCES

1. Ameer A. Hilal, Nicholas H Thom, Andrew R Dawson,"The Use of Additives to Enhance Properties of Preformed Foamed Concrete",IACSIT International Journal of Engineering and Technology, Vol. 7, No. 4, August 2015
2. B Karthikeyan , R Selvaraj , Saravanan,"Mechanical Properties of Foam Concrete
International journal of earth Sciences and engineering ISSN 0974-5904,Volume 08 No 22"
3. DR. A. S. Kangalakshmi, K. Sasikumar, E. BrittoPravin, "An Investigation of Foam Concrete with quarry dust replacement for filler in mix design'',International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE) ISSN:0976-1353 Volume 13 Issue 1 –MARCH 2015
4. E. K. Kunhanandan,Nambiar Ramamurthy K,"Shrinkage Behavior of Foam Concrete", Journal of Materials in Civil Engineering 21(11) November 2009 DOI: 10.1061/(ASCE)0899- 1561(2009)21:11(631)
5. HanizamAwang, Muhammad Hafiz Ahmad,"Durability Properties of Foamed Concrete withFiber Inclusion", International Journal of Civil, Environmental, Structural, Construction andArchitectural Engineering Vol:8, No:3, 2014
6. K.Krishna ,BhavaniSiram , "Foam Concrete –The Present Generation's building solution", International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development (IJCSEIERD) ISSN 2249-6866 Vol. 3, Issue 4, Oct 2013, 59-62
7. MD Jalal, AftabTanveer, K Jagdeesh,Furqan Ahmed, "Foam Concrete", International Journal of Civil

Engineering Research. ISSN 2278-3652 Volume 8, Number 1 (2017), pp. 1-14

8. Mahesh Kumar H. Thakrele,“ Experimental Study on Foam Concrete”, International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development (IJCSEIERD) ISSN(P): 2249-6866; ISSN(E): 2249-7978 Vol. 4, Issue 1, Feb 2014,145-158
9. Shibi Varghese, Ashik M Ashok, Atheena K Joseph2, Shaniyo Emmanuel2, Swathylekshmi O V, “ A study on properties of foamed concrete with natural and synthetic foaming agent ”,International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395 - 0056, p-ISSN: 2395-0072, Volume: 04 Issue: 03 | Mar - 2017, 2009- 2011.