

A study on properties of foamed concrete with natural and synthetic foaming agent

Shibi Varghese¹, Ashik M Ashok², Atheena K Joseph², Shaniyo Emmanuel², Swathylekshmi O V²

¹Professor, Dept. of Civil Engineering, Mar Athanasius College of Engineering, Kerala, India

²Student, Dept. of Civil Engineering, Mar Athanasius College of Engineering, Kerala, India

Abstract - Foamed concrete consists of cement, water, fine aggregate and air voids. It is relatively homogeneous and do not contain coarse aggregate phase. Properties of foamed concrete depends on the type of binder and foaming agent used. Here two types of foaming agents are used – natural and synthetic. A partial replacement of binding material is done with silica fume which provides additional strength compared to foam concrete without silica fume. This paper which based on the foam concrete properties and preparation process analyses the research progress of silica fume effect on performance of foamed concrete.

Key Words: Foamed concrete, soap nut, silica fume.

1. INTRODUCTION

Foamed concrete consists of cement, water, fine aggregate and air voids. It is relatively homogeneous and do not contain coarse aggregate phase. Properties of foamed concrete depends on the type of binder and foaming agent used. Here two types of foaming agents are used – natural and synthetic. A partial replacement of binding material is done with silica fume which provides additional strength compared to foam concrete without silica fume. This paper which based on the foam concrete properties and preparation process analyses the research progress of silica fume effect on performance of foamed concrete.

The focus of this project is to do an investigation on properties of foamed concrete with silica fume and identifying its mechanical properties . The impact of microstructure & its implication on development of strength, elastic modulus & transport properties in order to fully benefit from light weight properties is focused in this paper. Two different foaming agents are used and their hardened properties were measured. Outcomes showed that foaming agent type had a noticeable effect on mechanical properties. Foamed concrete is a new type of light weight high strength and energy saving building material widely used in construction industry. This paper which is based on foam concrete properties and preparation process analysis and also the research progress of blending materials, admixtures and fibers effect on the performance of foamed concrete,

puts forward the problem about development and application of foam concrete in current research.

2. CHARACTERISTICS OF FOAMED CONCRETE AND ITS PREPARATION PROCESS

1) *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.

2) *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.

3) *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.

4) *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.

5) *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.

2.1 Preparation technology of foamed concrete

Preparation of natural foam.

Soap nut is taken in required amount ,say 8 in number and is cleaned .It is boiled in 1 liter water for 10 minute at a temperature 110^oc and temperature is lowered to 70^oc and it is maintained for 30 minutes. It is then cooled to room temperature. This solution is taken for foam preparation.

Preparation of foamed concrete.

The foam is dispersed in the cement slurry evenly, then the cement slurry concretes the foam in the condition of natural curing, thereby foamed concrete is formed. Therefore, the foam's own stability and foaming capacity play an important role in the formation of foamed concrete. The production process of foamed concrete is mainly composed of four parts, which are mixing, foaming, mixture stirring and molding. The mixing process is the formation process of cement slurry; foaming process is the process of preparing uniform and stable foam; mixture stirring is the process of making the foam and cement slurry stir evenly; molding is the process of making the mixing slurry cast.

3. RESULTS

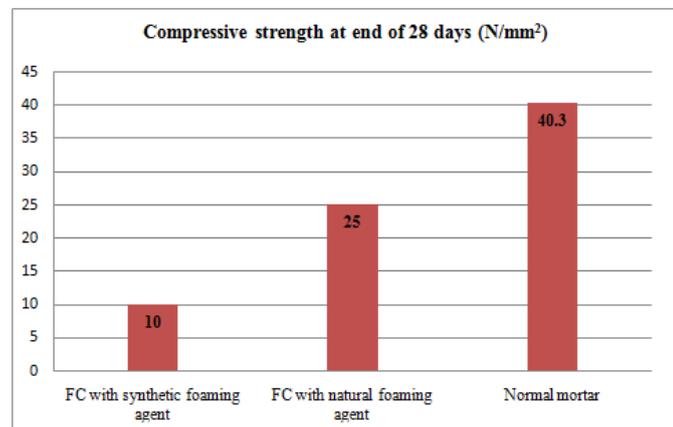


Chart -1: Compressive strength of cubes.

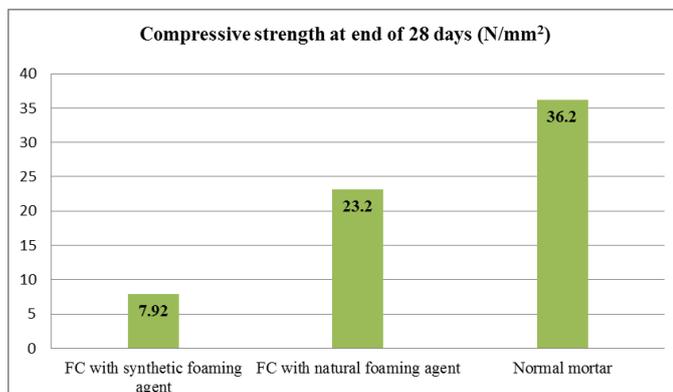


Chart -2: Compressive strength of cylinders.

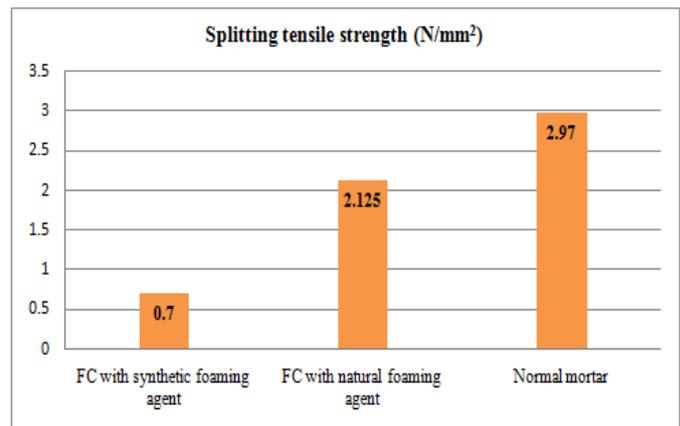


Chart -3: Splitting tensile strength

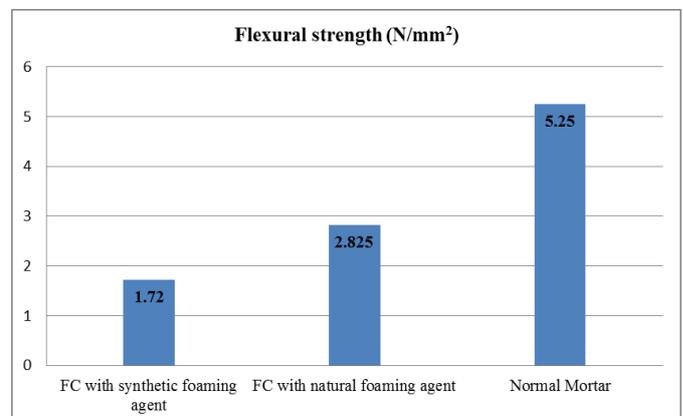


Chart -4: Flexural strength.

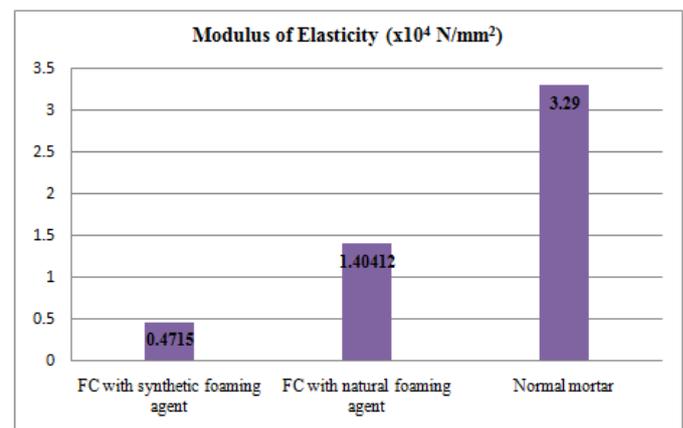


Chart -5: Modulus of elasticity.

Comparison of test results			
PROPERTIES	FC with Synthetic foaming agent	FC with Natural foaming agent	Normal mortar
Compressive strength of cube (N/mm ²)	10	25	40.3
Compressive strength of cylinder (N/mm ²)	7.92	23.2	36.2
Splitting Tensile strength (N/mm ²)	0.7	2.125	2.97

Flexural strength (N/mm ²)	1.72	2.825	5.25
Modulus of elasticity (N/mm ²)	0.4715 x 10 ⁴	1.404 x 10 ⁴	3.29 x 10 ⁴

Table -1: Comparison of results

4. CONCLUSIONS

This study revealed that FC can be prepared by using the natural foaming agent. The following conclusions can be drawn from the results of this work.

- 1) Comparing to synthetic foaming agents ,the natural foaming agents are more easily available and are less expensive.
- 2) Natural foam has lower consistency and strength. Hence for a given proportion, the density of FC with natural foaming agents higher than that of foam concrete with synthetic foaming agents.
- 3) For a given proportion, the ratio of compressive strength, flexural strength and splitting tensile strength for FC with synthetic foaming agents to that of FC with natural foaming agents were obtained as 0.4,0.61 & 0.33 respectively.
- 4)Compressive strength of FC, both natural and synthetic, was influenced by the substitution of silica fumes.

ACKNOWLEDGEMENT

We take this opportunity to express our sincere gratitude to our project guide Prof. Shibi Varghese, Dept of Civil Engineering, for his tremendous support and guidance throughout the project work. We would also like to express our sincere thanks to all the staff members of the Civil Engineering Department who has provided assistance during the course of the project. Finally, we would like to thank our family and friends for their comments, criticisms and appreciations.

REFERENCES

- [1] K. Ramamurthy, E.K. Kunhanandan Nambiar, G Indu Siva Ranjani, "A classification of studies on properties of foam concrete". Cement and concrete composites 31(2009) 388-396.
- [2] Ashish S. Moon, Dr. Valsson Varghese, S. S. Waghmare, "Foam concrete as a green building material." International journal for research in emerging science and technology, vol-2, issue-9, sept 2015.
- [3] Qin Xin, "Research status of foamed concrete" International journal of multidisciplinary research and development ,vol 3; issue 4; april 2016; 328-330.
- [4] Zuhua Zhang, John L. Provis, Andrew Reid, Hao Wang, "Mechanical, thermal insulation, thermal resistance and acoustic absorption properties of geopolymer foam concrete (gfc)." Cement&concrete composites 62 (2015) 97-105.
- [5] Ali J. Hamad, "Materials, production, properties and application of aerated lightweight concrete: review" International journal of materials science and engineering vol. 2, december 2014.

- [6] Jun Jiang, Zhongyuan Lu, Yunhuiniu, Jun Li, Yuping Zhang, "Study on the preparation and properties of high-porosity foamed concretes based on ordinary portland cement"
- [7] D.K. Panesar, "Cellular concrete properties and the effect of synthetic and protein foaming agents." Construction and building materials 44 (2013) 575-584.
- [8] Khamphuejitchaiyaphuma,Theerawatsinsiria, PrinyaChindaprasirtb, "Cellular lightweight concrete containing pozzolan materials." Procedia engineering 14 (2011) 1157-1164.