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Study on Properties of GGBFS and Flyash incorporated Foam Concrete with Filler Materials-A review

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Abstract - *Foam concrete a type of lightweight concrete, is a special type of concrete that typically includes cement, water, preformed foam and fine sands, in conjunction with other sand-like fine Foamed particles such as fly ash or silica fume or GGBFS.As mostly no coarse aggregate is used for production of foam concrete the correct term would be called mortar instead of concrete; it may be called "foamed cement" as well. The density of foam concrete usually varies from 400 kg/m3 to 1600 kg/m3. The density is normally controlled by substituting fully or part of the fine aggregate with foam.High-density foam concrete is (1200–1600 kg/m3) commonly used for the production of load-bearing structures.Foam is a major component of the foam concrete, which can be manufactured either by pre-foaming process or mixed foaming Process.Foam is generated during the process of mixing and will resulted in a cellular structure in concrete.This paper discuss on the properties of Foam concrete when different waste materials are added.*

Key Words:Foam Concrete, Flyash, GGBFS, Microstructure, Compressive strength

1.INTRODUCTION

Light weight concrete is a very new idea of creating a low weight concrete.This special type of concrete which is having weight less than conventional concrete.This type of concrete can be made by either light weight aggregate concrete, foamed concrete or autoclaved aerated concrete.Such light weight concrete blocks are often used for house construction.

1.1 Foam Concrete

Foamed concrete can be either made as a mortar or cement pastes in which air-voids can be artificially entrapped in into the mortar mix. It possesses low self-weight, high flowability, controlled low strength, minimal usage of aggregate, and excellent thermal insulation properties.

The density variation in Foam Concrete can be achieved by the addition in the amount of foam.Usually density of Foam Concrete varies in the range 400– 1850 kg/m3. Density between the range 300 -600 kg/m3 is used for insulation purposes whereas Foam concrete in the range 600-1200 kg/m3 is used for production of non load bearing structures like panels for outer leaves of building, partition wall etc.High density Foam concrete of density in the range 1200-1600 kg/m3 is used for load bearing structures.

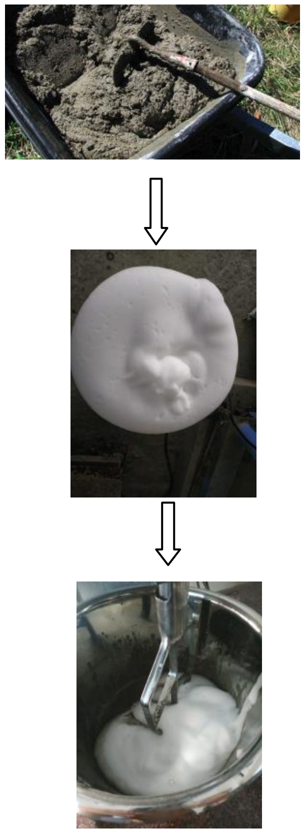

Fig-1: Making of Foam Concrete

1.2 Method of Preparation

On the method of pore-formation in the concrete, it can be classified into two types.They are Air-en trained concrete and foam concrete. In the method of air-entraining, certain gas-forming chemicals are mixed into mortar and during mixing of the paste certain chemical reaction will take place which will generate gas leads to produce a good porous structure. Various types of chemicals used are Aluminium powder, calcium carbide and hydrogen peroxide. In the foaming method, pores are formed by mechanical means either by the pre-foaming process (foaming agent mixed with the mixing water) or by mixed foaming process (foaming agent mixed with the mortar).[1]

2. SUPPLEMENTARY MATERIALS

Cement is usually used as the bonding material which is having good cohesive and adhesive properties which make it capable to bind different construction materials and form the compacted assembly. Ordinary Portland cement is one of the most widely used types of Portland cement.[2].Rapid hardening Portland cement, high alumina and Calcium Sulfoaluminate are also used for reducing the setting time and to improve the early strength of foam concrete.[3]

For decreasing the heat of hydration of foam concrete, ordinary cement can be replaced with waste materials like silica fume, ground granulated blast furnace slag, and fly ash about 10 to 75%.

Introduction of ground granulated blast furnace slag (GGBFS) which is a waste material. It can be used as a substitute of cement may help to minimize solid waste disposal and thus can reduce material cost. Due to its cementatious and pozzolanic character it can be well substituted for cement. Due to its microfilling ability, the compressive strength can also be increased.

By the addition of flyash in a mix, during its early ages it shows beneficial toughness and fatigue.But as age increases the fatigue resistance starts decreasing.The main reason behind this is the shape and size of the flyash particles compared with other materials in the flaw.The flyash particles will not create a bond with other particles but create round flaws which will affect the toughness.The size of this flaws depend directly on the size of flyash particles.[4].

Fig 2: Flyash

When GGBFS is replaced with 20%, 40% and 60% of cement, it shows decrease in strength when compared with plain concrete mix.The optimum percentage of cement replacement with GGBFS varies with the curing duration. When cement is replaced with higher content, it takes more time for initial and final set[5].

Fig 3: GGBFS

3. FILLER MATERIALS

Various waste materials can be used to substitute the fine aggregate. Such that solid waste management can be improved. Also some of the waste material usage show more water absorption whereas some show decrease in strength.

3.1 Rubber

When rubber is added to foam concrete by replacing sand its density decreases. The main reason for this because rubber is having lower density compared with sand.When rubber is replaced by sand with about 7.5%, its split tensile strength increases. After 7.5% increment of rubber causes decrease in strength In case of flexural strength, it increases with increase in rubber content but beyond 17% it start to decrease[6].The main reason behind the decrease in strength due to addition of rubber is that it has less adhesion between crumb and cement paste.This will lead to formation of crack and propagation in inter facial zone between RTC and hydrated cement[7].The water absorption rate of rubber concrete mix will be more because it creates more voids which lead to more water absorption.

Fig 4: Rubber crumbs

3.2 Glass

When glass is added to mix by replacing sand the degree of shrinkage in the paste decreases. Also it shows improvements at low densities in the strength of the porous matrix .When foam is added at higher quantity with sand aggregates can leads to lower strength development due to decrease in the density of mix and a higher amount of pore connectivity in the sand group. Therefore, while the thermal performance is better in the sand group at higher densities, the larger size and inter-connectivity of the voids deteriorates the thermal performance of this group at lower densities. With the lowest thermal conductivity at a density of 600 kg/m3(0.15 W/mK), the glass group becomes the most favourable insulating material at this density[8]

3.3 Rice husk ash

When rice husk ash (RHA) partially used in cement can be found to be durable, environmental friendly and economically viable.At a low water to cement ratio of 0.30–0.34, the use of high binder contents along with RHA and super plasticizer has enabled to gain a high workable and cohesive mix without the problem of segregation. The increased water demand due to the addition of RHA was compensated by the use of superplasticizer. Compressive strength of concrete increased with increasing amount of RHA, up to 20%.

3.4 Quarry dust

When Fly ash 30% added with quarry dust to cement and sand can produce better quality of light weight foam concrete.When 30% of fly ash with 30% of quarry dust shows that the split tensile strength is 1.75 MPa at 28 days with the w/b ratio of 0.4. Depends on experimental test results for various mixes, to obtain the optimum percentage of fly ash 30% along with 30% of quarry dust stone powder with 6% of foam is taken into consideration.So this type of cellular concrete is recommended based on the test results, wherever required for non-load bearing wall or partition wall this type of foam concrete is more suitable for building construction industries due to minimizing the self-weight of the member than compared to brick masonry wall which is consisting of 30% of fly ash replaced in Portland cement along with 30% quarry dust replaced in river sand.

Fig 5: Quarry dust

3.5 Plastic Granules

When plastic granules are added to the Foam concrete its compressive strength decreases due to the poor bonding between the smooth surface of plastic and cement paste. The plastic is having impervious nature and high capacity of water absorption. The plastic is a hydrophobic material that restricts water requirement for cement hydration. Also plastic cannot interact with cement paste which makes the ITZ weaker thus reducing the compressive strength of concrete.

Fig 6: Plastic granules

4. CONCLUSIONS

The Foam concrete is well advanced new idea which can be used where more strength by weight ratio is needed. There are various waste materials which can be used in it by replacing the cement and fine aggregate partially. This usage of waste material can reduce much waste production also the properties of Foam concrete can be sometimes enhanced.

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