Research Paper Engineering

Experimental Study on High-Performance Concrete, with Mixing of Alccofine and Flyash

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ABSTRACT

The aim of this research was to evaluate the performance of high performance concretes(HPC) Containing supplementary cementitious materials. In the last millennium concrete had demanding requirements both in terms technical performance and economy and yet greatly varied from architectural masterpieces to the simplest of utilities. The main aim of the investigation program is first to prepare the Strength of concrete of grade M80 with locally available ingredients and then to study the effects of different proportions of Alccofine and fly ash in the mix and to find optimum range of Alccofine and fly ash content in the mix. The Alccofine and fly ash is added by weight of cement as a replacement. The Concrete specimens were tested at different age level for Mechanical Properties of concrete, namely, Cube Compressive Strength, Flexural Strength.

Keywords : High performance concrete, alccofine, flyash , cement, aggretes,etc

INTRODUCTION

High performance concrete are used extensively throughout the world where oil, gas, nuclear, high rise building and power industries are among users. The applications of such concrete are increasing day by day due to their superior structural performance, environmental friendliness, and energy conserving implication. The search for alternative binders, cement replacement material, has been carried out for decades. Research has been conducted on the use of fly ash, volcanic pumice, pulverized-fuel ash, blast slag and silica fume and micro silica as cement replacement material. These materials can also improve the durability of concrete and the rate of gain in strength and can also reduce the rate of the liberation of heat, which is beneficial for mass concrete. Concrete containing mineral admixture are used extensively throughout the world for their good performance and for ecological and economic reasons.

AIM AND OBJECTIVE OF THE RESEARCH

The primary aim of this investigation was to evaluate the influence of high volumes of SCMs on the properties of HPC. More specifically, the research had the following objectives:

1. To study the hydration properties and its significance on properties of HPC;
2. To investigate the effects of various replacement levels of FA (class F) and allcofine on compressive strength and durability properties of concrete; and
3. To evaluate the compressive response of various SCMs on the properties of HPC.

NEED OF HPC

Hpc is required as a construction material in structures constructed in very several environments. The structures like tunnels in sea beds, tunnels and pipes carrying sewage, offshore piers and platforms, confinements structures for solid and liquid wastes containing toxic chemicals and radioactive elements, jetties and ports, sea link bridges pier and superstructures and high rise structures, chimney and towers, foundations and piles in aggressive environment. Concrete has performed reasonably well in the past in favorable environment, if design and constructed properly. Concrete strength, which is easily regulated by controlling the water-cement ratio, has served well in the past as the principal criterion for performance of ordinary concrete.

ALCCOFINE

ALCCOFINE 1203 is a specially processed product based on high glass content with high reactivity obtained through the process of controlled granulation. The raw materials are composed primary of low calcium silicates. The processing with other select ingredients results in controlled particle size distribution (PSD). The computed blain value based on PSD is around 12000cm2/gm and is truly ultra fine. Due to its unique chemistry and ultra fine particlesize, ALCCOFINE1203 provides reduced water demand for a given workability, even up to 70% replacement level as per requirement of concrete performance. ALCCOFINE 1203 can also be used as a high range water reducer to improve compressive strength or as a super workability aid to improve flow.

FOLLOWINGS ARE THE PROPERTIES OF ALCCOFINE :

1) STRENGTH

Alccofine 1203 results in to formation of dense pore structure and inbuilt CaO provides increased secondary hydrated product because of which improved strength gain at early as well as later ages observed.

2) WORKABILITY & COHESIVENESS

Alccofine 1203 have better particle size distribution compared to other Supplementary Cementitious Materials which

provides dense matrix pore structure resulting in to reduced water contains and batter workability.

3) LOWER THE HEAT OF HYDRATION
Alccofine 1203 has the lime contain 34% which provides more quantum of secondary hydrated product. This results in prolonged chemical reaction and responsible for reduced heat liberated by the hydration process.

4) FLOWABILITY
Alccofine 1203 has batter particle packing which results in to increased rheology resulting in to improved flow ability.

FLY ASH (FA)
Fly ash (FA) class F, known also as pulverized- fuel ash, is the byproduct obtained by electrostatic and mechanical means from flue gases of power station furnaces fired with pulverized coal. FA is complicated in its chemical and phase compositions. It consists of heterogeneous combinations of glassy and crystalline phases. However, wide ranges exist in the amounts of the three principal constituents- SiO2 (25 to 60%), Al2O3 (10 to 30%), and Fe2O3 (5 to 25%). FA can be categorized into two classes, i.e. Class F and Class C, according to ASTM C 618-99 (1999). If the sum of these three ingredients is 70% or greater, the FA is categorized as Class F. However, as Class C, FA generally contain significant percentages of calcium compounds reported as CaO, the sum of the three constituents just mentioned is required only to be greater than 50%. It is generally accepted that, in the pozzolanic reaction of FA, the Ca(OH)2 produced during cement hydration reacts with the silicate and aluminate phases of FA to produce calcium silicate and aluminate hydrates (Lea, 1970). Its pozzolanic activities attributed to the presence of SiO2 and Al2O3 in amorphous form (Wesche, 1991). Due to its pozzolanic reaction, FA can beneficially affect various properties of concrete. The details of which are discussed in later sections.

COARSE AGGREGATE:
For high performance concrete, the coarse aggregate particles themselves must be strong. From both strength and rheological considerations, the coarse aggregate particles should be roughly equi-dimensional; either crushed rock or natural gravels, particularly if they are of glacial origin, are suitable. In addition, it is important to ensure that the aggregate is clean, since a layer of silt or clay will reduce the cement-aggregate bond strength, in addition to increasing the water demand.

FINE AGGREGATE:
The fine aggregate should consist of smooth rounded particles, to reduce the water demand. It is recommended that the grading should lie on the coarser side of the limits, a fineness modulus of 3.0 or greater is recommended, both to decrease the water requirements and to improve the workability of these paste-rich mixes. Of course, the sand too must be free of silt or clay particles.

In this Work, the coarse aggregate selected is of 20mm and 10mm crushed type and fine aggregate of natural river sand locally available.

EXPERIMENTAL PROGRAMME:

FINDINGS OF AGGREGATE					
AGGREGATES-(FINE, COARSE (FRECTION I & II) (Ref. Standard:IS 2386)					
Sr. No	Test Name	Unit	Fine Aggregate Sand	Coarse Aggregate Fraction - I 20 mm	Coarse Aggregate Fraction - II 10 mm
1	Silt Content	%	0.98	NA	NA
2	Specific Gravity	---	2.6	2.83	2.80
3	Bulk Density	Kg/m^3	1565	1465	1499
4	Water Absorption	%	1.1	0.92	1.12
5	Free Surface Moisture	%	0	0	0

FINDINGS OF CEMENT	
Tests	Results
Normal Consistency %	29.50 %
Initial setting time test	69
Final setting time test	195
Fineness test	5% retained
Specific gravity	3.15
Soundness test	2.00
Compressive strength	
7 days	37 N/mm2
28 days	58 N/mm2

BY ACI363 GUIDELINES (HPC)
MIX DESIGN OF M80(HPC)

PROPORTION	WATER	CEMENT	FLYASH	
By weight (kg/m^3)	145.5	442.3	104.8	
weight	0.25	1	0.24	
Volume	0.25	1	0.28	
Conti……				
PROPORTION	ALCCO	SAND	C.A	
			20	10
By weight (kg/m^3)	34.9	693.9	674.1	449.4
weight	0.08	1.19	1.16	0.77
Volume	0.13	1.10	1.14	o.74

MIX PROPORTION:

MATERIAL/ MIX PROPORTION	A1	A2	A3	A4	A5
CEMENT	76%	76%	76%	76%	76%
	442.3	442.3	442.3	442.3	442.3
FLYASH	18%	16%	14%	15%	17%
	104.8	93.2	81.5	87.3	99
ALCCOFINE	6%	8%	10%	9%	7%
	34.9	46.6%	58.2	52.4	40.7
C.A.1	449.4	449.4	449.4	449.4	449.4
C.A.2	674.1	674.1	674.1	674.1	674.1
SAND	693.3	693.3	693.3	693.3	693.3
WATER	145.5	145.5	145.5	145.5	145.5

COMPRESSIVE STRENGTH TEST:
The compressive strength is finding out by compression testing machine for different proportion of concrete mix. This is the long term strength study,thus we have selected different age of concrete Such as 7 Days, 28 Days, 56 Days and 90 Days. The cube mould of 150mm x 150mm x 150mm size is taken as per IS: 516-1959 specification.

COMPRESSIVE STRENGTH(M80):

MIX	3 DAYS N/mm^2	7 DAYS N/mm^2	14 DAYS N/mm^2	28 DAYS N/mm^2
A1	34.73	50.84	74.12	84.32
A2	46.76	62.69	78.12	89.3
A3	39.76	52.69	75.12	78.3
A4	36.8	52.8	75.3	82.4
A5	42.7	60.6	77.9	85.3

a). IMAGE OF COMPRESSIVE TEST OF A2 8%ALCCO & 16%FLYASH

FLEXURAL STRENGTH TEST

The beam flexural strength was made as per the IS: 516-1959 specification by flexural machine for different proportion of concrete mix. For this study the concrete beams of size 100mm x 100mm x 500mm were prepared. Total 2 Nos. of beams were cast for each proportion in the Concrete mix. Beams were c ured for 28 Days and 90 Days time age. The beams were placed normal to the casting and symmetrical two point system was adopted for the flexural tensile strength test. The deflection of the beams was measured by the dial gauge of LC=0.01mm, which was placed in the middle third portion of the beam.

$$Pl/bd^2$$

Flexural Strength [F_b] =

FLEXURAL STRENGTH:

PROPORTION	14 DAYS KN/m	28DAYS KN/m
A1	3.5	6.8
A2	3.6	6.92
A3	3.45	6.5
A4	3.52	6.55
A5	3.55	6.57

CONCLUDING REMARKS:

1) Where, I get perfect proportion of replacing cement material as Alccofine and flyash without losing its strength.
2) Alccofine has better performance compare to other slag materials and microsilica. It is helpful to make concrete workable.
3) By increasing or trying various dosage of Alccofine and fly ash we get better result on 8% of Alccofine and 16% of flyash.
4) I have conclude that by verifying the various dosage of Alccofine and flyash we get different strength at different proportion at starting age of concrete till end we get perfect strength at 28 days, so that Alccofine helps to increase strength in both compressive and flexural strength upto certain limit(6%, 7%, 8%).

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REFERENCES

• ICI-ACECON 2010, IIT MADRAS, CHENNAI,INDIA | ICI Journal | ICJ Journal | • Agarawal S.K., Singh L.P., Juneja Deepak,I.siddiquie,Avdesh Kumar,(2009) "Use of high volume flyash in concrete for building sector",CE & CR, October,pp 71-90 | • S. K. Kaushik, Virendra Kumar and V. P. Bhargava, "Mechanical Properties of High Strength Concrete: A review" From: - The Indian Concrete Journal, August: 2001, Vol.: 75, No.: 8 | • S. P. Shah and S. H. Ahmad, High Performance Concrete Properties and Applications. | • Shah, S.P. (2000), "High performance concrete: past, present and future", Proceedings of High Performance Concrete - Workability, Strength and Durability, Hong Kong, v 1, p 3-29 | • 18. Young, J.F. (2000), "The Chemical and Micro-structural Basis for High Performance Concrete", Proceedings of High Performance Concrete – Workability, Strength and Durability, Hong Kong, 1, 2000, p 87-103 | • By Reddy B.D, Reddy G.B "An Experimental investigation on micro silica with fly ash on concrete strength behavior" (2006) | |