High Performance Concrete with Partial Replacement of Cement by Alccofine

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Abstract- Alternative concretes are needed to reduce the significant environmental impact of ordinary Portland cement concrete construction. Although fly ash as a partial replacement for cement has been utilized for many years, it has been almost exclusively used in low-volume percentages, such as 10 or 20% cement replacement which reduces the cost of concreting but it affect on concrete inversely. In this study cement is partially replaced by ALCCOFINE and fly ash for M60 grade of concrete. The compressive strength of concrete of OPC concrete and with ALCCOFINE and fly ash is compared and it has been found that the strength of concrete got increased by 20% with partial replacement of cement by ALCCOFINE and the cost also reduced.

Key word: - HPC, fly ash, ALCCOFINE, economy

I. INTRODUCTION

With an annual production exceeding 2 billion metric tons per year, concrete is the single most widely used manufactured substance on earth owing to its remarkable versatility as a building material (Crow 2008). One drawback of concrete as a building material is the harmful effects the production of its components has on the environment. Using alternate/green materials in concrete to replace the Portland cement and natural aggregates can mitigate these negative impacts The total cost of any construction work is directly related with volume of concrete used

during construction. Portland cement is the most energy intensive and environmentally taxing component of conventional concrete. During its production, fuel is combusted to heat raw materials to temperatures exceeding 1,500°C, causing the decarbonation of limestone to occur. During this process, 0.81 kg of CO2=kg of cement is released owing to fuel combustion and decarbonation (Hendriks et al. 2000). Concrete is typically the most massive individual material element in the built environment. If the embodied energy of concrete can be reduced without decreasing performance or increasing cost, significant environmental and economic benefits may be realized. Concrete is primarily comprised of Portland cement, aggregate, and water. Although Portland cement typically only comprises 12% of the concrete mass, it accounts for approximately 93% of the total embodied energy of concrete and 6 to 7% of the worldwide CO2 emissions (Mehta 1998). A large number of papers available with replacement of cement with fly ash In this paper strength of concrete is investigated along with cost comparison between OPC concrete and concrete with fly ash and ALCCOFINE. In high performance concrete applications, Silica Fume is generally proposed as the appropriate cement extender where high strength, low permeability are the prime requirements. Though silica fume is known to improve durability, its addition in concrete is often negated by the increase water and/or admixture dosage required to improve the workability and handling properties of the fresh concrete. This paper focus on partial replacement of cement with fly ash and ALCCOFINE 1203. This replacement increase the strength, durability, resistance to chemical attack of concrete.

II. MATERIALS

53 grade Ordinary Portland cement conforming to BIS 12269-1987 is used. Fly ash (or) pulverized fly ash is

used which is a residue remains obtain from the combustion of pulverized coal collected by mechanical separators, from the fuel gases of thermal plants.

The coarse aggregate chosen for High performance concrete is typically round in shape, is well graded, and smaller in maximum size than that used for conventional concrete typical conventional concrete could have a maximum aggregate size of 20 mm or more. Polycarboxylate ether (PCE) type is very efficient dispersants for Calcium Aluminate cement based constables. They provide superb workability to the material in the fresh state, and excellent physical properties in the hardened state. ALCCOFINE 1203 is a specially processed product based on slag of 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 plain value based on PSD is around 12000 cm^2/gm and is truly ultra fine. Due to its unique chemistry and ultra fine particle size, 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. In this paper Compressive strength of OPC concrete is compared with concrete with ALCCOFINE.

Table 1 Properties of ALCCOFINE

Chemical Analysis	Mass %	Physical analysis	Range
CaO	32-34	Bulk Density	600-700 kg/m3
Al2O3	18-20	Surface Area	12000 cm2/gm
Fe2O3 SO3	1.8-2 0.3-0.7	Particle shape Particle Size, d10	Irregular < 2 μ
MgO	8-10	d50	< 5μ
SiO2	33-35	d90	< 9 μ

The chemical composition and physical characteristics listed in Table 1, ALCCOFINE 1203 has got the unique chemical composition mainly of CaO 31-33% and SiO2 33-35%. Physically the product is unique with regards to its particle size distribution. Figure: 1, demonstrates the comparative particle size distribution analysis.

III. MIX DESIGN CASTING AND CURING

Concrete is designed for M60 table 2 shows percentage constituting of each material.

After mix design concrete cement is tested for setting time and concrete is tested for workability. Specimen size of concrete sample for compressive strength test was taken as 150.0 mm X 150.0 mm X 150.0 mm to make better control. After 24 hrs of casting the cubes were de moulded and kept in normal tap water for curing.

Table 2 Compressive strength after 7 day.

Desingnation	Gread	Age At Test	Compressiv Strength N/MM^2
OPC+ALCCOFINE	M60	7	43.90
OPC+ALCCOFINE	M60	7	44.67
OPC+ALCCOFINE	M60	7	45.67
PURE OPC	M60	7	54.56
PURE OPC	M60	7	53.10
PURE OPC	M60	7	56.70

Table 3 Compressive strength results 28 days

Desingnation	Grade	Age At Test	Strength N/mm^2
OPC+ALCCOFINE	M60	28	71.13
OPC+ALCCOFINE	M60	28	71.96
OPC+ALCCOFINE	M60	28	73.37
PURE OPC	M60	28	66.09
PURE OPC	M60	28	65.23
PURE OPC	M60	28	66.52

IV. RESULT AND DISCUSSION

Concrete cubes are tested for compressive strength in CTM after 7 days and 28 days. table shows compressive strength of cubes while figure shows comparison between OPC concrete and concrete with ALCCOFINE and flyash. Our 2nd trial was failed because it was not take proper initial strength; the flyash content which are used for this trial is up 30 %. So as per IS suggestions flyash is use upto 30-35% but it not in case of high performance concrete.

V.CONCLUSION

The following conclusions can be drawn from this investigation:

- Cost of OPC concrete with PFA is minimum but we cannot get good compressive strength due to fly ash.
- Cost of concrete with PFA and ALCCOFINE is less than pure OPC concrete but the strength is increased. So in construction industry the use of fly ash with

ALCCOFINE should required to promote which also reduce the harmful effect of fly ash.

- The compressive strength of concrete increases with increase ALCCOFINE and fly ash content in HPC up to 15-20 %.
- High density of the mix was achieved and subsequently higher packing value.
- Cube failure pattern was dumb bell showing aggregate crushing dominantly.
- As per cost concern ALCCOFINE is cheaper than cement so for better strength and durability of concrete it should be promoted in Indian construction industry.

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