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A Survey on Minerals Admixture High Performance Concrete

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ABSTRACT: High Performance concrete (HPC) has gained augmented interest in the growth of infrastructure Viz., Buildings, Industrial Structures, Hydraulic Structures, Bridges and Highways etc. leading to utilization of large quantity of concrete. So in this paper, a short review of literature regarding the power of mineral admixtures (fly ash, GGBS and silica fume), chemical admixtures on the new concrete, and their result on strength and stability behavior of concrete is reported and discussed. Literature regarding mix proportioning of HPC is also discussed.

Keywords: Chemical Admixtures; Conventional Concrete; High Performance Concrete; Mineral Admixtures

1. INTRODUCTION

Concrete is extensively used construction material in India with annual consumption more than 100 million cubic metres. Common Ordinary Portland Cement Concrete which is intended on the basis of compressive power does not meet many useful requirements as it is found deficit in aggressive environments, time of construction, energy absorption capability, repair and retrofitting jobs etc. So, there's a desire to style High Performance Concrete that is way superior to standard concrete because the Ingredients of High Performance Concrete contribute most Expeditiously to the assorted properties. A High Performance Concrete could be a concrete within which bound characteristics area unit developed for a specific application and atmosphere in order that it'll provide glorious performance within the structure within which it'll be placed, within the atmosphere to that it'll be exposed, and with the hundreds to that it'll be subjected throughout its style life [1]. High Performance Concrete is additionally outlined as concrete which meets special performance and uniformity necessities that cannot be invariably achieved habitually by using standard materials and traditional combination, placing and hardening practices [2]. The necessities could involve enhancement of placement and compaction while not segregation, long term mechanical properties, early age strength, volume stability or service life in severe environments. The ingredients typically utilized in investigations are 1) Cement; 2) Fine Aggregate; 3) Coarse Aggregate; 4) Water; 5) Mineral Admixtures; and 6) Chemical Admixtures.

2. LITERATURE REVIEW

2.1 INFLUENCE OF MINERAL ADMIXTURES ON FRESH CONCRETE

Incorporation of various admixtures like fly ash, GGBS and silica fume in concrete can significantly enhance the basic properties in both fresh and hardened states. Some of the literatures related to workability of fresh concrete are described here.

Fulton (1974), Rajamane et al. (1998) investigated the workability of concrete containing GGBS in greater detail and suggested that the cementitious matrix containing GGBS exhibited greater workability due to the increased paste content and increased cohesiveness of the paste. Meusel and Rose (1982) reported that the water demand for normal concrete is generally 3 to 5 percent lower than concrete with GGBS for trial mixture proportioning studies.

Grutzeck et al. (1982) reported that the concrete containing silica fume shows significantly reduced bleeding. This effect is caused primarily by the high surface area of the silica fume to be wetted; there is very little free water left in the mixture for bleeding. Additionally, the silica fume reduces bleeding by physically blocking the pores in the fresh concrete. Jahren (1983) reported that fresh concrete containing silica fume is more cohesive and less prone to segregation than concrete without silica fume.

Scali et al. (1987) reported that the water demand of concrete containing silica fume increases with increasing amount of silica fume at the stage of fresh concrete. Osborne (1989) reported the test results of slump, veebee time and compaction factor for concrete containing zero, 40 and 70 percent GGBS and concluded that when the percentage of GGBS is increased, the workability properties is reduced.

Hossam et al. (1995) reported that the optimum benefit of the addition of silica fume is attained when it is used in combination with superplasticizers. This combination increases the cohesiveness of the fresh composites and reduces the water content.

2.2. STRENGTH CHARACTERISTICS OF HIGH PERFORMANCE CONCRETE

The literatures related to effect of addition of fly ash, GGBS and silica fume on various strength properties like compressive strength, splitting tensile strength, flexural strength, bond strength and modulus of elasticity of HPC are discussed here.

Aitcin et al. (1990) found that there is some small retrogression in strength due to the drying of a very thin layer of the skin of the HPC. This strength retrogression of HPC is due to severe drying conditions. Hence it is emphasized that proper early water curing is much more important for HPC, especially when most of the hydration reactions are taking place. He found that some HPC laboratory specimens experienced a slight decrease in compressive strength after a long period of curing in air, particularly that containing silica fume.

Bentz et al. (1990) conducted experiments on silica fume concrete and developed a model for simulating the development of microstructure in the interfacial transition zone region in concrete. Based on the simulation and experimental results, they revealed that the strength development is much earlier than with Portland cement alone. The contribution of silica fume to the early strength development up to 7 days is probably through improvement in packing, that is, acting as filler and improvement of the interface zone with the aggregate.

Khan and Lyssdale (2002) experimented with binary and ternary cementitious system based on ordinary Portland cement, pulverized fuel ash and silica fume on strength, permeability and carbonation of HPC. They pointed out that the incorporation of silica fume content increases the early strength, compensating for the early age strength loss as a result of pulverized fuel ash inclusion. It was found that the incorporation of 8-12 percent silica fume yielded the optimum strength and permeability values.

Hogan and Meusal (1981) conducted experiments on development of strength and durability properties on concrete and reported that the compressive and flexural strength-gain characteristics of concrete containing GGBS can vary over a wide range. When compared to Portland cement concrete, use of GGBS typically results in reduced strength at early ages (1 to 3 days) and increased strength at later ages (7 days and beyond).

2.3. DURABILITY CHARACTERISTICS OF HIGH PERFORMANCE CONCRETE

One of the principal reasons for the deterioration of many concrete structures stems from the fact that, in the past and even now, too much importance has been given to concrete compressive strength when designing concrete structures and not enough to the environmental factors that the structure will have to face while performing its structural function. However, in recent years a new attitude can be perceived towards durability in various national codes of India, Japan, Australia, Europe (Rostam and Schissel, 1993) and Canada.

Gautefall (1986) examined the chloride- diffusion rates in pastes made from ordinary Portland cement and a blended cement containing 10 percent fly ash with silica fume contents ranging from zero to 15 percent. He also reported that the addition of silica fume led to a decreased chloride diffusivity, more for the ordinary Portland cement than for the blended cement. Concrete structure in hostile chloride environments are some of the most logical candidates the silica fume concrete. A great amount of testing to determine the resistance of silica fume concrete to chloride ion penetration has been performed.

During and Hicks (1991) reported that among the various mineral additives used in concrete structures, the silica fume is highly preferred for its superior concrete durability properties. The influence of silica fume on permeability is more than that on compressive strength. The reduction in the diffusivity of chlorides due to the presence of silica fume in hydrated cement paste is larger at water-cement ratio greater than 0.4. The sulphate resistance of concrete containing silica fume is good, partly because of a lower permeability, and partly in consequence of a lower content of calcium hydroxide and of alumina, which have become incorporated in C-S-H. Silica fume is particularly very effective in controlling expansive alkali-silica reaction. Shrinkage of concrete containing silica fume is somewhat more than in Portland cement concrete.

Dhir et al. (1997) carried out experiments for developing chloride resisting concrete using Pulverized Fuel Ash (PFA). The PFA concrete mixes were designed to optimize resistance to chloride ingress. They found that up to 33 percent PFA level, the chloride binding capacity was the dominant factor in improving the resistance to chloride attack.

Thomas et al. (1999) studied the durability of concrete containing ternary blends of Portland cement, silica fume and a wide range of fly ashes and concluded that the ternary blends offer significant advantages over binary blends and even greater enhancement over plain Portland cement. The combination of silica fume and fly ash is complementary, and the silica fume improves the early age performance of concrete with the fly ash continuously refining the properties of the hardened concrete as it matures. In terms of durability, such blends are superior to plain Portland cement concrete.

Ternary blends enabled chloride permeability values to reduce to negligible levels at early age with contributions from both pulverized fuel ash and silica fume. Silica fume inclusion, by up to 12.5 percent replacement level, significantly reduced chloride permeability for all levels of pulverized fuel ash replacements. Above 10 percent silica fume, the reductions in permeability were marginal.

Ganesh babu and Sree Ramakumar (2000) studied the chloride diffusivity of GGBS concretes and reported that chloride ion diffusion resistance of GGBS concretes were high compared to normal concretes. The resistance increased with an increase in percentage replacement of cement by GGBS, up to 15 percent.

2.4. MIX PROPORTIONING FOR HIGH PERFORMANCE CONCRETE

The mix proportioning method for HPC only provides a starting mix design that will have to be more or less modified to meet the desired concrete characteristics.

Aitcin (1988) proposed a very simple method which can be used for both air-entrained and non air-entrained HPC. The procedure involves the following steps: selection of water binder ratio (from the graph), water content that depends upon the saturation point of superplasticizer (from table), superplasticizer dosage (assume 1 percent, if saturation point is not known), coarse aggregate content as a function of its shape and entrapped air content (assume value) and determination of the mass of fine aggregate by absolute volume method.

Mehta and Aitcin (1990) proposed a simplified mix proportioning procedure that is applicable for normal weight concrete with compressive strength values between 60 and 130 MPa. The method is suitable for the coarse aggregates varying a maximum size between 10 and 15 mm and slump 22 values of between 200 and 250 mm. It assumes that non-air can be increased to 5 to 6 percent when the concrete is air-entrained. The optimum value of aggregate is suggested to be 65 percent of the volume of the HPC

Then ACI 363 committee (1993) proposed a mix design for high strength concrete in which the maximum size of aggregate suggested was 19 or 25 mm for concrete with strength less than 65 MPa, and 10 or 13 mm for concrete made with strength greater than 85 MPa. The formula has been suggested to find the dry weight of coarse aggregate. A computerized programme has been developed from this method and is currently used in France under the trade name of BETONLAB (Sedran and Larrard, 1996).

Ganesh Babu and Siva Nageswara Rao (1993) reported that the contribution of the fly ash is not a constant determined solely by its physical and chemical characteristics but also varies depending on the type of cement, w/c ratio, etc. Siva Nageswara Rao (1996) and Bharatkumar et al. (2001) proposed a mix proportioning method to obtain strength to effective w/b ratio relationship for a given set of materials and for the same workability for the HPC with fly ash and ground granulated blast furnace slag. When mineral admixtures are used, their effect on the strength of concrete varies significantly depending on the properties of mineral admixtures and with the characteristics of concrete mixture.

3. CONCLUSION

From the literature analysis, it's understood that adequate analysis has been done to check the strength and sturdiness aspects of HPC victimization mineral admixtures like ash, GGBS and oxide fume severally with cement (binary system). it's conjointly clear that no adequate analysis has been twenty four done on HPC victimization ternary and quaternary blends. thus during this study it's planned to check the incorporation of ash associated GGBS as cement replacement materials with oxide fume as an addition in binary, ternary and quaternary blends on the strength and sturdiness characteristics of HPC. it's conjointly planned to formulate a mixture style procedure supported potency of admixtures for the on top of mixing systems.

REFERENCES

[1] A. Kmita, “A New Generation of Concrete in Civil Engineering,” Journal of Materials Processing Technology, Vol. 106, No. 1-3, 2000, pp.80-86. doi:10.1016/S0924-0136(00)00642-7

[2] M. J. Shannag and H. A. Shaia, “Sulfate Resistance of High-Performance Concrete”, Cement & Concrete Composites, Vol. 25, No. 3, 2003, pp. 363-369. doi:10.1016/S0958-9465(02)00049-5

[3] N. V. Ramana, K. Gnaneswar, C. Sashidhar and T. Naresh Kumar, “Behavior of High Performance Concrete Two Way Slabs in Punching Shear”, International Journal of Science and Advanced Technology, Vol. 2, No. 3, 2012, pp. 122-126.

[4] P. Muthupriya, K. Subramanian and B. G. Vishnuram, “Experimental Investigation on High Performance Reinforced Concrete Column with Silica Fume and Fly Ash as Admixtures”, Asian Journal of Civil Engineering (Building and Housing), Vol. 12, No. 5, 2011, pp. 597-618.

[5] S. A. Al-Mishhadani, W. A. Al-Qaisi and S. F. Al-Khafaji, “Predicting Mechanical Properties of High Performance Concrete by Using Non-Destructive Tests,” Journal of Engineering & Technology, Vol. 27, No. 3, 2009, pp. 425-444.

[6] B. B. Patil and P. D. Kumbhar, “Strength and Durability Properties of High Performance Concrete Incorporating High Reactivity Metakaolin,” International Journal of Modern Engineering Research, Vol. 2, No. 3, 2012, pp. 1099-1104.

[7] V. G. Ghorpade and H. S. Rao, “Chloride Ion Permeability Studies of Metakaolin Based High Performance Concrete,” International Journal of Engineering Science and Technology ,Vol. 3, No. 2, 2011, pp. 1617-1623.

[8] S. Bhanja and B. Sengupta, "Influence of Silica Fume on the Tensile Strength of Concrete," Cement and Concrete Research, Vol. 35, No. 4, 2005, pp. 743-747. doi:10.1016/j.cemconres.2004.05.024

[9] K. Yildiz and L. O. Ugur, "Examinatıon of Durablity of High Performance Concrete (hpc) That Has Been Subjected to MgSO4 and NaCl Corrosıon against Freezing and Thawing," Scientific Research and Essay, Vol. 4, No. 9, 2009, pp. 929-935.

[10] A. I. Laskar and S. Talukdar, "Rheological Behavior of High Performance Concrete with Mineral Admixtures and Their Blending," Construction and Building Materials, Vol. 22, No. 12, 2008, pp. 2345-2354. doi:10.1016/j.conbuildmat.2007.10.004

[11] A. H. Memon, S. S. Radin, M. F. M. Zain and J. F. Trottier, "Effects of Mineral and Chemical Admixtures on High-Strength Concrete in Seawater," Cement and Concrete Research, Vol. 32, No. 3, 2002, pp. 373-377. doi:10.1016/S0008-8846(01)00687-1

[12] I. R. F. Martins and J. L. Akasaki, "Study of Compressive Strength of High Performance Concrete Added with Tire Rubber", Materials Compuestos, 2005, pp. 1-8.

[13] V. Malagavelli and P. N. Rao, "High Performance Concrete with Ggbs and Robo Sand," International Journal of Engineering Science and Technology, Vol. 2, No. 10, 2010, pp. 5107-5113.

[14] K. Pazhani and R. Jeyaraj, "Study on Durability of High Performance Concrete with Industrial Wastes," Applied Technologies & Innovations, Vol. 2, No. 2, 2011, pp. 19- 28.

[15] J. A. Peter, M. Neelamegam, J. K. Dattatreya, N. P. Rajamane and S. Gopalkrishnan, "Utilisation of Flyash as Cement Replacement Material to Produce High Perfor