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Research Paper

EFFECT OF MINERAL ADMIXTURE ON THE MECHANICAL AND DURABILITY PROPERTIES OF HIGH PERFORMANCE CONCRETE

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The conventional concrete has lost its usage in modern days as it does not serve the present needs. Hence to improve the workability, durability and the ultimate strength of the concrete, High Performance Concrete (HPC) with super plasticizers and pozzolans are used. There are various studies and research that are emerging related to the HPC. This study is mainly concentrated on the durability characteristics of HPC with partial replacement of cement by fly ash. The cement was replaced with 15% by fly ash. Water cement ratio and super plasticizer dosage are kept constant for all mixtures. It was observed that the HPC with 15% flyash shows markable change in strength and durability characteristics of concrete.

Keywords: Durability, Fly ash, High performance concrete, Mineral admixtures, Chemical admixtures

INTRODUCTION

Concrete is a durable and versatile construction material. It is not only strong, economical and takes the shape of the form in which it is placed, but also aesthetically satisfying. However experience has shown that concrete is vulnerable to deterioration, unless precautionary measures are taken during the design and production. For this it is necessary to understand the influence of components on the behaviour of concrete and to produce a concrete mix within closely controlled tolerances.

HPC is a concrete made with appropriate materials combined according to a selected mix design; properly mixed, transported, placed, consolidated and cured so that the resulting concrete will give excellent performance in the structure in which it is placed, in the environment to which it is exposed and with the loads to which it will be subject for its design life. Mix proportions for HPC are influenced by many factors, including specified performance properties, locally available materials, local experience, personal preferences and cost. The HPC does not

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require special ingredients or special equipments except careful design and production. HPC has improved durability characteristics and much lesser micro-cracking than normal strength concrete.

Engineers are making increasing use of HPC since it is designed to give optimized performance characteristics for the given set of materials, usage and exposure conditions, consistent with requirements of cost, service life and durability. HPC works out to be economical even though its initial cost is higher than that of conventional concrete; it's because the use of HPC in construction enhances the service life of the structure and the structure suffers less damage which would reduce overall costs.

EXPERIMENTAL STUDY

Materials

The materials used for coarse aggregate, natural sand, fly ash, silica fume and 53 grades ordinary Portland cement. The sand and coarse aggregate used for locally available in the market and usual materials used. The fly ash was replaced with 15% for cement. Fly ash was collected from Mettur Thermal Power Plant and confirms to ASTM Class F. By laboratory tests the specific gravity of fly ash was obtained as 2.08. Super plasticizers, also known as high range water reducers, are chemicals used as admixtures where well-dispersed particle suspensions are required. ASTM C 494 type F as a high range water reducing admixture (CERA PLAST 300) was used.

Methods

The materials are collected and the mix proportions are to be obtained. For acquiring the mix proportions basics tests are to be carried to find the specific gravity of cement, fine aggregate, coarse aggregate along with fineness of fine and coarse aggregate are obtained.

Table 1: Values for the Mix Design	
Specific gravity of cement	3.15
Specific gravity of FA	2.62
Specific gravity of CA	2.7052
Fineness of FA	2.38
Fineness of FA	6.98

With all the above values mix design is done and the following proportions are used.

Table 2: Materials Required for Various Mixes

	Controlled mix	**Mix Having 15% Fly Ash**
Cement	441.2 Kg/m³	375.02 Kg/ m³
Water	150 Kg/m³	150 Kg/m³
Fine aggregate	696.95 Kg/m³	696.95 Kg/m³
Flyash	0	66.18 Kg/m³
Course aggregate	1075 Kg/m³	1075 Kg/m³
Admixture	4.412 Kg/m³	4.412 Kg/m³
Water cement ratio	0.34	0.34

Analysis was carried out in concrete mixtures with the flyash at 15% and controlled mix concrete. The specimens were casted, tested to study the possibility of using fly ash as the substitute materials for cement in concrete. The control mix using fly ash replaced as the cement was designed for cubes, beams and cylinders. The specimens were investigated to determine the compressive, split tensile strength in cubes and cylinders respectively. The tests for durability will be done in the upcoming days.

RESULTS AND DISCUSSION

Based on the laboratory test it has been observed that strength of concrete is increasing with addition of admixtures. The various tests that are conducted to test the strength and durability characteristics and their results correlate with the study and derive positive result and improvement.

Figure 1: Compression Testing on Cube

Table 3: Compressive Strength of Concrete

	7th Day (N/mm²)	28th Day (N/mm²)
Controlled mix	42	72
Mix with 15% fly ash	40	75

Table 4: Split Tensile Strength of Concrete

	28th Day (N/mm²)
Controlled mix	5.8
Mix with 15% fly ash	4.3

Figure 2: Split Tensile Strength Test

CONCLUSION

The principal conclusions of the present investigation are:

- By the addition of fly the workability of the mix was improved.
- The inclusion of mineral admixture significantly influences the compressive strength of the HPC mixes. The flyash mix exhibited higher strength values at later ages than controlled mix. Flyash mix exhibited a strength lower than controlled mix at early ages but the rate of strength development for the mix was found to increase after 7 day compared to controlled mix and ultimately it exceeds the strength of controlled mix.
- In case of split tensile strength and flexural strength at 28 day, controlled mix showed the maximum value compared to flyash mix.

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