International Journal of Advanced Technology in Engineering and Science
Vol. No.3, Issue 07, July 2015
www.ijates.com
ijates
ISSN 2348 - 7550

STUDY OF HIGH PERFORMANCE CONCRETE BY USING ADMIXTURES

Ch. Kusuma Keerthi[1], K. Rajasekhar[2]

[1]Student, [2]Professor, Department of Civil Engineering,

Siddartha Educational Academy Group of Institution/Integrated Campus , Tirupati, (Rural)

Jntua, Anathapuramu, (India)

ABSTRACT

High performance Concrete is the concrete meets the performance and requirements that are not to be obtained by conventional material, normal mixing, placing and curing practices. In this study, a brief review on strength and durability on M80 grade of concrete results, a new composite material has been developed and improved cements evolved. Important governing factors for HPC (High Performance Concrete) are strength, long term durability. As per Indian standard code IS: 456-2000 concrete of compressive strength≥60Mpa.concrete of grades M80 and M90 etc. are considered as High Performance Concrete (HPC). In this project mineral admixtures namely Fly Ash, Silica Fume, Slag& Metakaolin contributed by various reputed industries are used.

Keywords: Admixtures, Fly Ash, Metakaolin, Silica Fume and Slag

I. INTRODUCTION

Concrete is a strong& durable material. The most popular material Reinforced concrete is used though out the world for construction. After all experiments and researches respect to workability, strength and durability of concrete is increased very much and gives a special performance is called as “HPC”. It is a range of materials combining of products beyond the conventional mix concrete and construction methods.

1.1 Fly Ash

The combustion of coal by using flue gases, results the collection of electrostatic precipitator. The most widely used mineral admixture is fly ash over the world. Extensive research has given the benefits that can be achieved by utilization of fly ash. At present all over the world high volume of fly ash concrete is very much preferred. The generation of quality of flies ash from various plants to more extent & not ready to be used in concrete further processing is necessarily done. The governed quality of fly ash by IS: 3812-part I-2003.

1.2 Metakaoline

Considerable research has been done on activated ordinary clay and kaolinitic clay. These un purified materials have often been called as “metakaolin”. The product is white or cream in color, thermally activated, purified, called as “high reactive metakaolin”. It is also observed that cement paste undergoes distinct densification. High reactive metakailin by trade name “METACEM” is being manufactured in India by “SPECIALITY MINERALS DIVISION” in BARODA. Metakaolin that we have used in this project work was contributed by “AKARSHA SPECIALITIES IN CHENNAI”CALCINED CLAY – HIMACEM is a High Reactivity Metakaolin (HRM), which is manufactured by the high temperature treatment of specially selected kaolin under controlled conditions. It is a white mineral admixture, having very good pozzolanic properties. It reacts with free lime produced during the hydration of cement to form additional cementacious products.

1.3 Silica Fume

Silica fume is also referred as micro silica or condensed silica flume, and it is a material which is used as artificial mineral admixtures. Silica fume rises as an vapour oxide. They collected in cloth bags by cooling and condensing.The combination of silica fume and super plasticizer are the important materials for high performance concrete.The reduction of water helps the Silica fume becomes high dosage of plasticizer Pierre-Claude Aiticn and Adam Neville in one of their papers "High Performance Concrete" states that "strengths in the range of 60 to 80 MPa have been achieved. Silica fume that we have used in this project work was contributed by "AKARSHA SPECIALITIES in CHENNAI". Its properties are mentioned below.

Table: 1.1 Typicalanalysis

Physical state Solid	Non Hazardous
Appearance	Very fine powder
Particle size	25 microns – mean
Colors	Grey
Odor	Odorless
Specific Gravity	2.2
CHEMICAL COMPOSITION	
Silica – Sio2	>90.0%
Carbon	<2.0%
Moisture	<2.0%
L.O.I	<4.0%
Water Soluble	<6.0%

II. EXPERIMENTAL WORK

In the present proposal it is planned to conduct lab investigation using different proportions of mineral and chemical admixtures, for three grades of concrete $\mathbf{M_{80}}$.The investigation purpose is how the strength properties of concrete when mineral and chemical admixtures are used in a desirable proportion in all civil engineering constructions.

The following tests were conducted on the concrete:

- Compressive strength
- Type of cracking
- Durability

2.1 Cement

Zuari-53 grade ordinary Portland cement conforming to IS: 12269 were used in concrete.

2.2 Aggregates

For coarse aggregate crushed granite rock of 20mm maximum size was used.For fine aggregate Natural sand from Swarnamukhi River in Srikalahasti was used.

Table: 2.1physical Properties of Aggregate

Specific Gravity of coarse aggregate	2.76
Specific Gravity of fine aggregate	2.60

2.3 Water

Potable water is used for curing and mixing of concrete cubes.

2.4 Admixtures

The addition of chemicals to concrete at the stage of mixing for modification of the properties of the mix is called admixtures.

2.5 Micro Silica

Micro silica increases concrete strengths producing financial benefits to builders, developers and property owners. Columns and wall thickness are reduced providing cost saving and improved construction schedules. The internal cohesiveness of micro silica ensures a smooth formwork finish.

2.6 Experimental Investigation

The cube specimen of size 15cm X 15cm X 15cm was cast to test various concrete mixtures for compressive strength. The cubes are removed from the moulds and kept for curing. when cubes are removed from water at 7 days and 28 days the compressive strength was conducted. The water and grit on the cubes was removed before testing the cubes. The test was carried as per IS: 516-1959.

2.6.1 Compressive Strength Test

Compressive strength test is carried out in a 400 ton capacity compressive testing machine.

International Journal of Advanced Technology in Engineering and Science
Vol. No.3, Issue 07, July 2015
www.ijates.com
ijates
ISSN 2348 - 7550

Table2.2 Compressive Strength Test Results For 7 Days & 28days

S.No	Grade of concrete	Compressive strength of 7 days (MPa)	Compressive Strength of 28 days (MPa)
1.	M_{80}	39.00	74.00
2.	M_{80} + FLYASH 20%	36.40	82.00
3.	M_{80} + FLYASH 15% + SILICA FUME 5%	41.00	85.30
4.	M_{80} + FLYASH 15% + METAKAOLIN 5%	42.00	89.30
5.	M80 + FLY ASH 15% + SLAG 5%	38.2	79.6

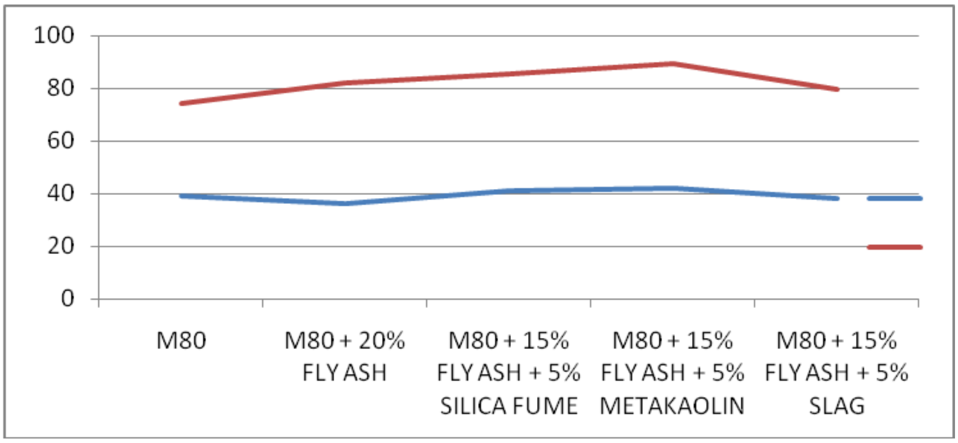

Figure: 2.1 Compressive Strength of Concrete For 7 Days & 28 Days

2.7 Cylinder Splitting Tension Test

Ft = 2P/ (¶ d l)

Where P= maximum tensile load

l = cylinder length

International Journal of Advanced Technology in Engineering and Science
Vol. No.3, Issue 07, July 2015
www.ijates.com
ijates
ISSN 2348 - 7550

d = cylinder diameter

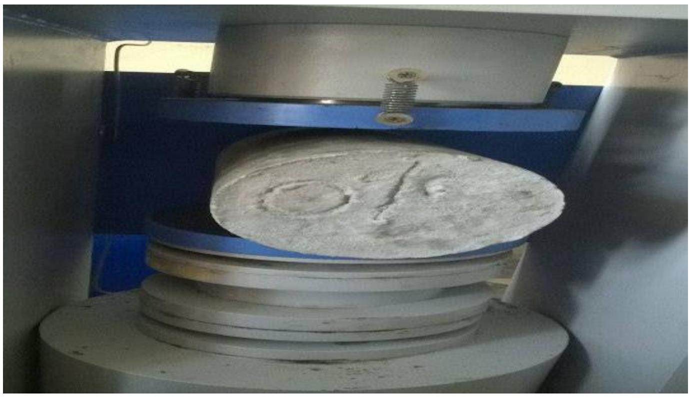

Figure 2.2 Split Tube Tensile Test

Table: 2.3 Tensile Strength Test Results For 7 Days & 28days

S.No	Grade of concrete	Split- tensile strength of 7 days (MPa)	Split- tensile Strength of 28 days (MPa)
1.	M_{80}	2.79	6.2
2.	M_{80} + FLYASH 20%	2.7	6.0
3.	M_{80} + FLYASH 15% + SILICA FUME 5%	2.655	5.9
4.	M_{80} + FLYASH 15% + METAKAOLIN 5%	2.835	6.3
5.	M80 + FLY ASH 15% + SLAG 5%	2.745	6.1

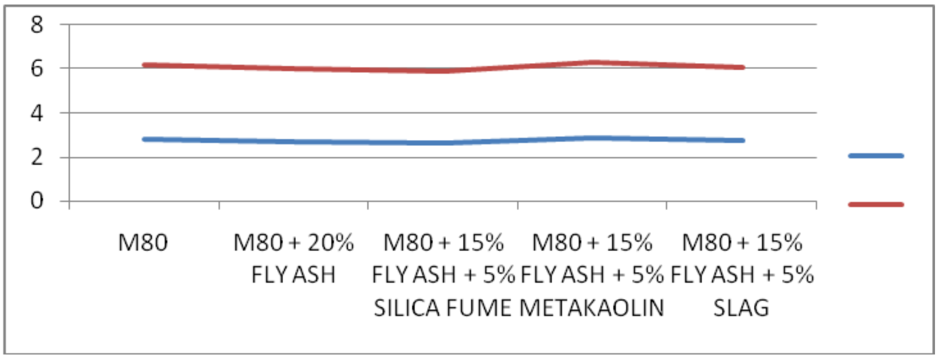

Figure:2.2 Tensile Strength Results for 7 Days and 28 Days

2.8 Flexural Strength Test

The modulus of rupture or flexural strength of concrete measures the tensile strength. The value of modulus of rupture depends upon the dimensions of the beam on the load arrangement.

$$f_b = \frac{P \times l}{b \times d^2}$$

when 'a' is greater than 20.0 cm for 15.0 cm specimen, or

$$f_b = \frac{3P \times a}{b \times d^2}$$

when 'a' is less than 20.0 cm but greater than 17.0 cm for 15.0 cm specimen

b = measured width in cm of the specimen,

d = measured depth in cm of the specimen at the point of failure.

L = length in cm of the span on which the specimen was supported, and

P = maximum load in kg applied to the specimen.

If 'a' is less than 17.0 cm for a 15.0 cm specimen, or less than 11.0 cm for a 10.0 cm specimen, the results of the test be discarded.

Figure: 2.3 Flexural Strength by One-Point Method

Table: 2.4 Flexural Stength Test Results for 7 Days & 28 Days

S.No	Grade of concrete	Flexural strength Of 7 days (MPa)	Flexural Strength of 28 days (MPa)
1.	M_{80}	2.745	6.1
2.	M_{80} + FLYASH 20%	2.61	5.8
3.	M_{80} + FLYASH 15% + SILICA FUME 5%	2.655	5.9
4.	M_{80} + FLYASH 15% + METAKAOLIN 5%	2.81	6.26
5.	M80 + FLY ASH 15% + SLAG 5%	2.565	5.7

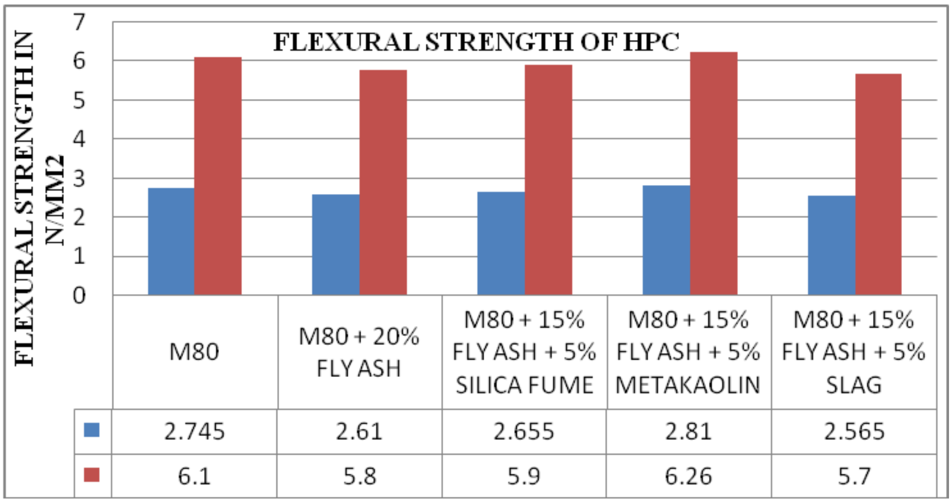

Figure:2.4 Flexural Strength For 7 Days & 28 Days

2.9 Tests for Acid Attack

The cube specimens of size 150 mm of various concrete mixtures removed from the curing tank after 28 days of water curing and left to dry for 24hours.Concrete cube specimens weighed. The cubes are immersed in the water containing acid for28 days of curing and also 90 days of curing.

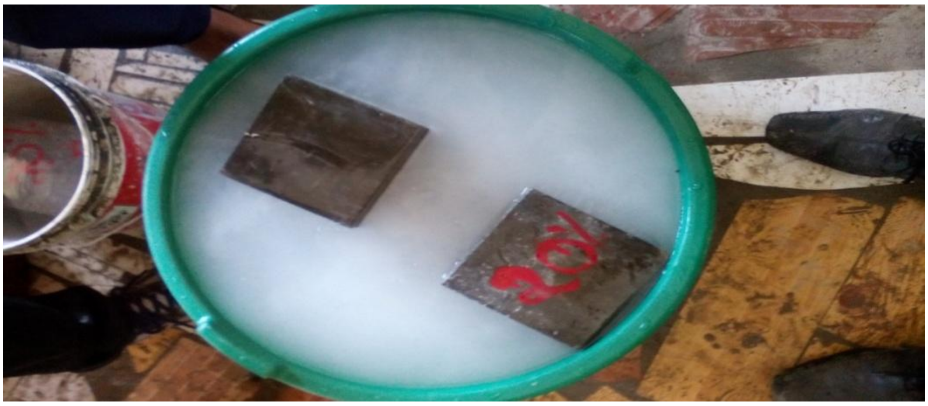

Figure 2.5: Acid Curing of Concrete Cubes

Table 2.5:% `Loss of Compressive Strength Reduction of Cubes After 28days

S.No	Grade of concrete	compressive strength with water curing	compressive strength after acid curing	% loss in compressive strength
1.	M80 (Conventional concrete)	74	71	4.05
2.	M80+ flyash 20%	82	79	3.65
3.	M80+ flyash 15% + silica fume 5%	85.3	82	3.86
4.	M80+ flyash 15% + Metakaolin 5%	89.3	88	1.455
5.	M80+ flyash 15% + Slag 5%	79.6	76.5	3.89

Figure 2.6: % Loss of Compressive Strength Reduction of Cubes After 28days

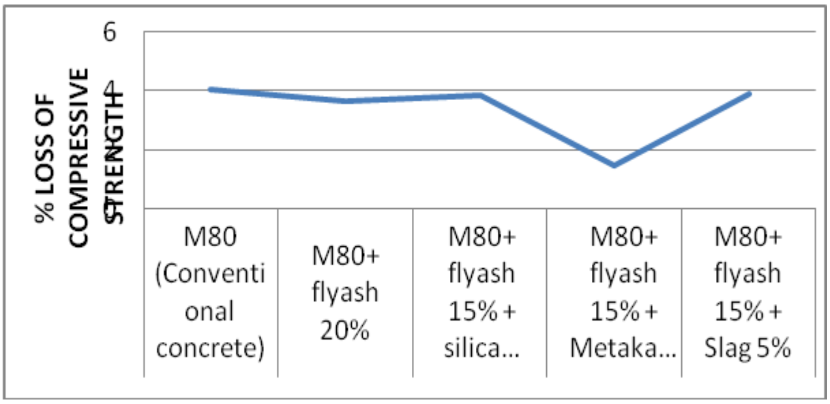

Figure 2.7: % Loss of Compressive Strength Reduction of Cubes After 28days

International Journal of Advanced Technology in Engineering and Science
Vol. No.3, Issue 07, July 2015
www.ijates.com
ijates
ISSN 2348 - 7550

2.10 Rapid Chloride Permeability Test

Table: 2.6test Results for Permeability Test for M80 Grade Concrete

S.NO	DESIGNATION OF MIX	TOTAL CHARGE PASSED THROUGH IN COULOMBS AT 28 DAYS	PERMEABILITY
1.	M80 FLY ASH+METAKAOLIN	74	VERY LOW
2.	M80 FLYASH	127	LOW

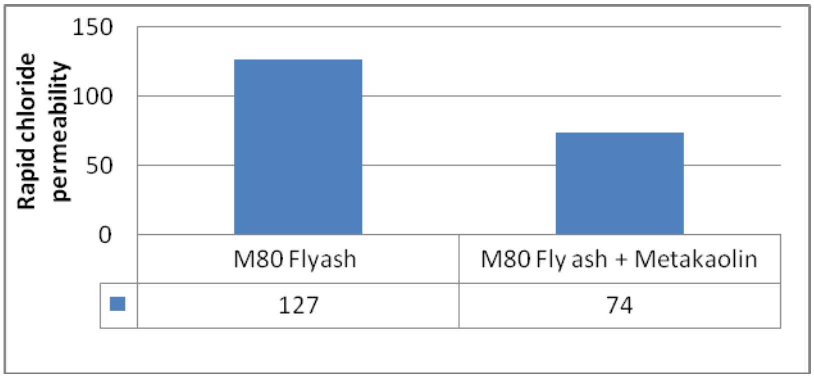

Figure: 2.7 Test Results for Permeability Test for M80 Grade Concrete

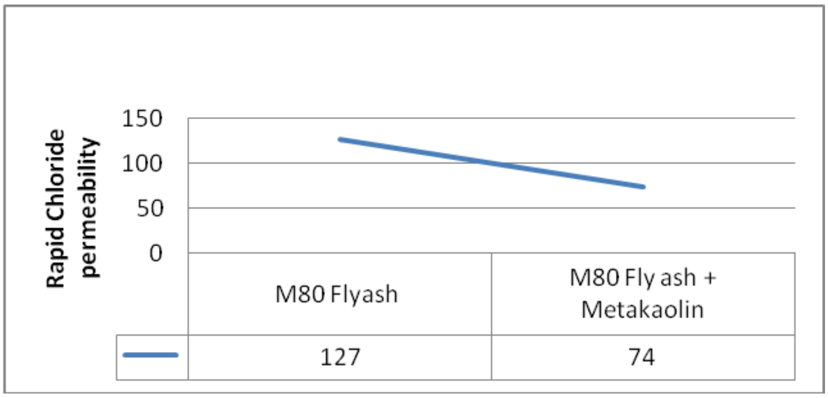

Figure: 2.8 Test Results for Permiability Test for M80 Grade Concrete

III. CONCLUSIONS

- In high performance concrete mix design as water cement ratio adopted is low, it is necessary to maintain super plasticizers for required workability. When the percentage of mineral admixtures in the mix increases super plasticizer percentage also increases for obtaining of required strength.
- In case of combination percentage replacement of mineral admixtures the maximum compressive strength achieved in M80 grade concrete in 89.3 Mpa with replacement of cement by15% fly ash and 5% Metakaolin
- Mineral admixtures such as Fly ash, micro silica, metkaolin& Slag also contribute effectively for achieving high strength.

- The scope of using high performance concrete in our constructional activities lies large, viz., precast, prestressed bridges, multi-storied buildings, bridges and structures on coastal areas and like. To affect this change, we will have to revise the designing to structures by encouraging use of high strengthconcrete.
- As soon as micro crack appears, sudden failure is observed in high strength concrete cubes.

REFERENCES

[1]. Mix Design for concrete (IS: 102622009)
[2]. Concrete technology by M.S. Shetty
[3]. High performance concrete by V.M. Malhotra
[4]. Design of concrete mixes by N. Krishna raju.
[5]. ACI journal, proc. V.81no.4, PP364-411.
[6]. Bureau of Indian standards, specification for casting of specimen IS: 102621962.
[7]. Ravindra Krishna, m.; SeshagiriRaoM.V; Giri Prasad. G (2004) “behaviour of high strength concrete using mineral and chemical admixtures”, proceedings of international conference on advances in Concrete and construction, Hyderabad, India, Dec. Pp 723-732
[8]. GaneshBabu K and Rao GSN “Efficiency of flyash in concrete with age; cement and concrete research 1996 vol. 26 No. 3pp 465-474
[9]. Ganesh ababu,Prakash P.V.S.GSN “Efficiency of silica fume in concrete with age; cement and concrete Research. 1995 vol. 25 No. 6pp 1273 – 1283