EXPERIMENTAL INVESTIGATION ON HIGH PERFORMANCE CONCRETE USING ALTERNATE MATERIALS

MUTHU KUMAR. T[1], SIRAJUDEEN. K[2]

Asst. Professor, Civil Engineering Department, Mohamed Sathak Engineering College, Kilakarai, Tamilnadu, India[1 2].

***Abstract*:** This paper deals with experimental investigation on high performance concrete using M50 grade mix proportion. High performance concrete achieved by, 100% replace the fine aggregate by crusher wash sand and partial replacement of cement by microsilica (i.e., 5%, 10%, 15%, 20% & 25%). Glenium b233 were added for workability of concrete mix. A result data obtained has been analyzed and compared with a control specimen. A relationship between Compressive strength vs. days, Tensile strength vs. days, and Flexural strength vs. days represented graphically. Result data clearly shows percentage increase in 7 and 28 days Compressive strength, Tensile strength and Flexural strength for M-50 Grade of Concrete.

Key words –crusher wash sand, Glenium B233, high performance concrete, micro silica.

I. INTRODUCTION: Concrete is a second largest material consumed by human being next to water. The present day investigations are aimed to produce high performance concretes. By using alternate materials like microsilica, crushers wash sand we can make the concrete as High performance. This can improve the strength, durability, long service life and also lowering permeability of the concrete.

High performance concrete is a concrete mixture, which possess high durability and high strength when compared to conventional concrete. This concrete contains one or more of cementious materials such as fly ash, microsilica or ground granulated blast furnace slag and usually a super plasticizer.

Microsilica - is a byproduct in the reduction of high-purity quartz with coke in electric arc furnaces in the production of silicon and ferrosilicon alloys. The material which contains more than 80% of silica in the form of extremely fine particles (0.1 µm average diameter).

Crusher wash sand - Digging the sand, from riverbed in access quantity, is hazardous to environment. The deep pits dug in the riverbed, effects on ground water level. Erosion of the nearby land is also due excess sand lifting. For this reason to fulfill the requirement some alternative materials we have to find out. The best alternate material is crusher wash sand. The properties of crusher wash sand nearly equal to the river sand and satisfies the IS requirements.

Glenium B233 - is an admixture of a new generation based on modified polycarboxylic ether. The product has been primarily developed for applications in high performance concrete where the highest durability and performance is required. GLENIUM B233 is free of chloride & low alkali. It is compatible with all types of cements.

II. EXPERIMENTAL PROGRAM

Materials Used

The main ingredients used in both normal as well as High Performance Concrete are the same namely ordinary portland cement, fine aggregate, coarse aggregate, water. But in High Performance concrete some additional ingredients such as mineral and chemical admixtures are used. It is only know how this constituent material which makes HPC different from normal concrete.

Cement - Ordinary Portland cement of 43 grade was used in this experimentation conforming to I.S-8112- 1989.

Crusher Wash Sand (fine aggregate) – crusher wash sand zone II with specific gravity 2.58, water absorption 2% and fineness modulus 3.00, conforming to I.S. – 383-1970.

Coarse aggregate - Crushed granite stones of maximum 20 mm size having specific gravity of 2.64, fineness modulus of 3.70, conforming to IS 383-1970

Water - Potable water was used for the experimentation.

Micro silica – the mineral admixture specific gravity 2.3 and other chemicals confirming to IS specification.

Glenium B233 (chemical admixture) - GLENIUM B233 has a different chemical structure from the traditional super plasticisers. It consists of a carboxylic ether polymer with long side chains. At the beginning of the mixing process it initiates the same electrostatic dispersion mechanism as the traditional super plasticisers, but the side chains linked to the polymer backbone generates a steric hindrance which greatly stabilizes the cement particles' ability to separate and disperse. Steric hindrance provides a physical barrier (alongside the electrostatic barrier) between the cement grains. With this process, flowable concrete with greatly reduced water content is obtained.

Concrete for M50 grade were prepared as per IS-10262:2009 with w/c 0.3. Mix proportion for M50 grade concrete for tested material as given in table 1:

ISSN: 2278 – 7798

Table 1: Concrete mix proportions

Material	Quantity	Proportion
Cement	600 kg/m^3	1
Crusher wash Sand	392 kg/m^3	0.66
Coarse aggregate	1199 kg/m^3	2.0
Water	180 kg/m^3	0.3
Microsilica	Each 5% replacement by the weight of cement	
Glenium B233	2% by the weight of cement	

III. METHODOLOGY

The tests have been performed to determine the mechanical properties such as compressive strength, splitting tensile-strength and flexural strength of concrete mix with each 5% replacement of microsilica by weight of cement.

a) Compressive Strength Test:

For compressive strength test, cube specimens of dimensions 150 x 150 x 150 mm was cast for M50 grade of concrete. The moulds were filled with concrete. Vibration was given to the moulds using table vibrator. The top surface of the specimen was leveled and finished. After 24 hours the specimens were demoulded and were transferred to curing tank where in they were allowed to cure for 7 days and 28 days. After 7 and 28 days curing, the cubes were tested on compression testing machine as per I.S. 516-1959. The failure load was noted. In each category, three cubes were tested and their average value is reported. Figure 1 shows, the testing of cube specimens by using compression testing machine. The compressive strength was calculated as follows:

Compressive strength (MPa) = Failure load / cross sectional area.

b) Split tensile strength test:

For split tensile strength test, cylinder specimens of dimension 150 mm diameter and 300 mm length were cast. The specimens were demoulded after 24 hours of casting and were transferred to curing tank where in they were allowed to cure for 28 days. These specimens were tested under compression testing machine. In each category, three cylinders were tested and their average value is reported. Figure 3 shows, the testing of cylindrical specimens by using compression testing machine.

Tensile strength was calculated as follows as split tensile strength:

Tensile strength (MPa) = $2P / \pi DL$,

Where, P = failure load, D = diameter of cylinder,

L = length of cylinder.

c) Flexural strength test:

For flexural strength test, beam specimens of dimension 100 mm depth and 100 mm width were cast. The specimens were demoulded after 24 hours of casting and were transferred to curing tank where in they were allowed to cure for 28 days. These specimens were tested under compression testing machine. In each category, three beams were tested and their average value is reported. Figure 5 shows, the testing of beam specimens by using universal testing machine.

Flexural strength (σ) = $(3PL) / (2bd^2)$

Where,
P = Maximum load applied to the specimen (N)
L = Span length (mm)
b = Average width of specimen, at the point of fracture (mm)
d = Average depth of specimen, at the point of fracture (mm)

IV. EXPERIMENTAL RESULTS

A. Compressive Strength Test Results

Compressive strength of concrete was calculated by above formula as per I.S. 516:1959 and the results are given in table 2:

Table2: Results of Compressive strength using cubes specimen

Days	Average compressive strength (N/mm^2)					
	0%	5%	10%	15%	20%	25%
7	32.15	34.77	36.10	37.4	40.1	35.5
28	57.2	59.8	62.54	63.70	66.60	60.50

Figure 1: Compression Test on Cube

ISSN: 2278 – 7798

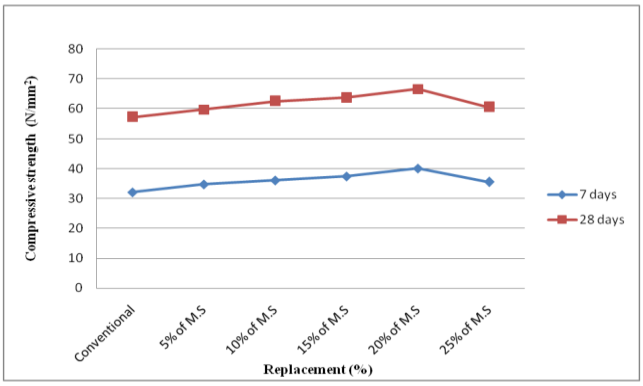

Figure 2: Compression Test on Cube

Fig.2 shows that, 20% of replacement of cement by microsilica gives max compressive strength using cube specimens among all the cubes.

B. Split Tensile Strength Results

Split tensile strength of concrete was calculated by above formula as per I.S. 5816:1999 and the results are given in table 3:

Table3: Results of Split tensile strength using cylinder specimen

Days	Average split tensile strength (N/mm^2)					
	0%	5%	10%	15%	20%	25%
28	3.06	3.37	3.54	3.77	4.20	3.74

Figure 3: Split tensile Test on Cylinder

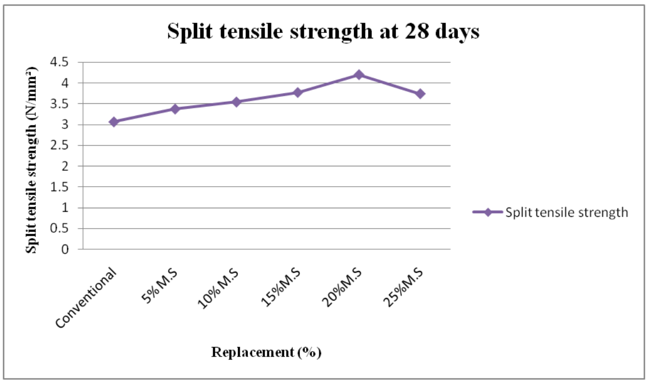

Figure 4: Split tensile Test on Cylinder

Fig.4 shows that, 20% of replacement of cement by microsilica gives max split tensile strength using cylinder specimens among all the cylinders.

C. Flexural Strength Results

Flexural strength of concrete was calculated by above formula as per I.S. codes and the results are given in table 4:

Table4: Results of Flexural strength using beam specimen

Days	Average split tensile strength (N/mm^2)					
	0%	5%	10%	15%	20%	25%
28	6.20	7.03	7.12	8.32	9.25	8.20

Figure 5: Flexural Test on Beam

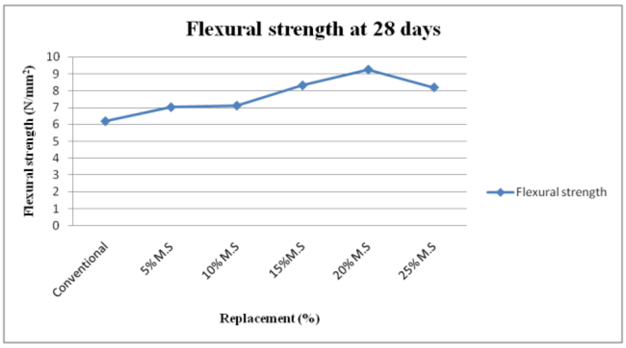

Figure 6: Flexural Test on Beam

ISSN: 2278 – 7798

Fig.6 shows that, 20% of replacement of cement by microsilica gives max flexural strength using beam specimens among all the beams.

V. CONCLUSIONS

The following conclusions could be drawn from the present investigation.

1. Using microsilica, crusher wash sand and super plasticizer improve the strength and durability of concrete when comparing the conventional concrete.
2. High Performance Concrete strength is achievable using microsilica.
3. Combination of microsilica, crusher wash sand and super plasticizer in this experimental study show a great improvement in the compressive strength as well as tensile properties.
4. Cement was replaced by microsilica by 20%, however strength increases by 16.5%.

REFERENCES

[1] BIS: 10262- 2009, “Concrete mix proportioning-guidelines” BIS New Delhi.

[2] BIS: 12269- 1987, “Specification for ordinary Portland cement” BIS New Delhi.

[3] BIS: 383- 1970, “Specifications for coarse and fine aggregate” BIS New Delhi.

[4] BIS: 456- 2000, “Plain and reinforced cement concrete code and practices” BIS New Delhi.

[5] BIS: 516- 1959, “Methods of tests for strength of concrete” BIS New Delhi.

[6] BIS: 5816- 1999, “Splitting tensile strength of concrete-method of test” BIS New Delhi.

[7] Dr. K. B. Pragash and N. K. Patil: Influence of replacement of cement by microsilica on flexural strength of fibrous ferrocement made from GI fibers” article on National Building Materials, April 2009.

[8] Gambhir M. L: “Concrete Technology," Tata McGraw-Hill publishing company limited, New Delhi, 1997.

[9] Ramados. P and Nagamani. K: “Investigation on the splitting tensile strength of high strength steel fiber reinforced micro silica concrete” article on National Building Material, February 2009.

[10] Shetty. M. S: “Concrete Technology” S.Chand & company limited,New Delhi,2011.

[11] SP:23- 1982, “Handbook of concrete mix” BIS New Delhi.

[12] *S.B.Kulkarni* - Effect of Dosing Sequence of Micro Silica on Slump & Compressive Strength of Concrete AVP, Technical Services & *Hemendra S*, Manager, Technical Services. UltraTech Cement Ltd. Mumbai – 2011.

[13] A. K. Gurav Effect of Replacement of Cement by Silica Fume on the Strength Properties of SIFCON Produced From Waste Coiled Steel Fibres article on National Building Material, march 2009.

AUTHORS

Muthukumar was born on 1990. He has completed his UG degree in Civil Engineering at 2011 and obtained PG degree in Structural engineering at 2014. Currently working as an Assistant Professor in Mohamed Sathak Engineering College, Kilakarai, Tamilnadu, India – 623 806.

Sirajudeen was born on 1991. He has completed his UG degree in Civil Engineering at 2012 and obtained PG degree in Structural engineering at 2014. Currently working as an Assistant Professor in Mohamed Sathak Engineering College, Kilakarai, Tamilnadu, India – 623 806.

ISSN: 2278 – 7798