Behavior and Comparison of High Strength Concrete (M45) Using Super Plasticizers (SP 430) As Admixture

M.ShivaRamaKrishna[1] , Koudagani Venkatesh[2] , Banoth Yakub[3], E Malathi[4]

[1,2]Asst. Prof., Department of Civil Engineering, Vaageswari College of Engineering

[3,4]P.G Student, Department of Civil Engineering, Vaagdevi College of Engineering

Email: muthojushiva@gmail.com , koudagani.venky@gmail.com , yakubbanoth09@gmail.com malathinchinna@gmail.com

ABSTRACT :

The aim of this paper is to study the High Strentgh Concrete of mix design M45 with P.P.C, O.P.C and compare the Mechanical Properties. Admixures have been used for generating High Strength Concrete and optimum dosage. Comparative studies of High Strentgh Concrete using P.P.C, O.P.C and by using 0.5%, and 1% of Super Plasticizer (S.P 430) with O.P.C.

KEYWORDS: High Strength Concrete, Mechanical Properties, Super Plasticizer-430, PPC,OPC.

INTRODUCTION

GENERAL

Many scientists in various countries have tried to modify the high strength concrete refers to concrete that has a uniaxial compressive strength greater than the usual strength obtained in particular region. This can be attributed to the fact that, as the development of concrete technology has continued, the strength that can be achieved has increased. In the 1990's concrete with a compressive strength greater than 110Mpa has been used in developed countries. However this numerical value (110Mpa) could be considerably lower depending on the characteristics of the local materials used for these concrete products, ACI committee 363 report in 1979 defined on High Strength Concrete as concrete having compressive strength more than 41.37 Mpa (6000 psi)

These days concrete is being used for so many engineering purposes in different conditions. In these conditions ordinary concrete may fail to exhibit the required quality or durability. In such cases admixture is used to modify the properties of ordinary concrete so as to make it more suitable for any situation.

Admixture: Conplast SP430(G) is used where a high degree of workability and its retention are required, where delays in transportation or placing are likely or when high ambient temperatures causes rapid slump loss. It facilitates production of high quality concrete.

Properties

Specific gravity 1.20 to 1.22 at 300C

Chloride content Nil. as per IS:9103-1999and BS:5075

Air entrainment Approx. 1% additional air over control

Compatibility: Can be used with all types of cements except high alumina cement. Conplast SP430 (G) is compatible with other types of Fosroc admixtures when added separately to the mix. Site trials should be carried out to optimize dosages.

Workability: Can be used to produce flowing concrete that requires no compaction. Some minor adjustments may be required to produce high workable mix without segregation.

Cohesion: Cohesion is improved due to dispersion of cement particles thus minimising segregation and improving surface finish.
Compressive strength: Early strength is increased upto 20% if water reduction is taken advantage of. Generally, there is improvement in strength upto 20% depending upon W/C ratio and other mix parameters.
Durability: Reduction in W/C ratio enables increase in density and impermeability thus enhancing durability of concrete.

Application instructions

Dosage

The optimum dosage is best determined by site trials with the concrete mix which enables the effects of workability, strength gain or cement reduction to be measured. Site trials with Conplast SP430 should always be compared with mix containing no admixture. As a guide, the rate of addition is generally in the range of 0.5 - 2.0 litres /100 kg cement.

Over dosing

An over dose of double the recommended amount of Conplast SP430, will result in very high workability and some retardation of setting time will occur. However, the ultimate compressive strength will not be impaired.

Dispensing The measured quantity of Conplast SP430 should be added along with the gauging water. For best results, add Conplast SP430 superplasticiser in the last phase after pre wetting the mix with 80% of the total water required.

Mix design

Fosroc has a dedicated advisory service on Concrete Mix Design and can be contacted if assistance is required.

Packing

Conplast SP430 is supplied in 5,20 and 200 litre drums.

Storage

Conplast SP430 has a minimum shelf life of 12 months when stored under normal temperatures. It should be protected from extreme temperatures and preferably stored in shade.

Precautions

Health and Safety instructions

Conplast SP430 is non-toxic. Any splashes on the skin should be washed immediately with water. Splashes on the eyes should be washed immediately with water and medical advice should be sought.

Fire

Conplast SP430 is non flammable

Literature review

V.M. Malhotra has studied the effect of super plasticizers (High range water reducers) in concrete and mentioned that plasticizing action of super plasticizers is of short duration (perhaps 10 minutes), after some 30 to 90 minutes the workability returns to normal. He further mentioned that the concrete does not get affected for its resistance to freezing, and thawing because of use of superplasticizer.

Mamillan .M has mentioned that with many plasticizing agents that allow a reduction in water content of the mix, the net result on shrinkage is negligible

Meyer .A has studied the use of super plasticizers in concrete; and mentioned that the chemical sulphonated naphthalene formaldehyde condensates, is more effective in dispersing the cement and generally having also some retarding properties. At a given water cement ratio, this dispersing action increases the workability of concrete typically by raising the slump from 75mm

to 200mm . Mix remaining cohesive and the resulting concrete can be placed with little are no compaction, and is not subjected to Excessive bleeding or segregation, and useful for placing in very heavily reinforced sections.

EXPERIMENTAL PROGRAMME

INTRODUCTION:

The experimental programme was drawn to compressive and split tensile strength of high strength concrete of M45 with OPC , PPC , and use of admixture

OUT LINE OF EXPERIMENTAL PROGRAMME:

The experimental program involved testing on 36 concrete cubical specimen of size150×150×150mm, 12 cylinders of 150mm dia and 300mm height. The concrete cubes, cylinders and beams were divided into three groups of OPC , PPC , admixture (conplastsp 430) of ½ % and 1%.

MATERIALS:

Fine Aggregate: Locally available river sand passing through I S 4.75mm sieve was used. Specific gravity of sand was found to be 2.56

Coarse Aggregate: Crushed granite stone chips size of maximum of 20mm was used. Specific gravity of aggregate was found to be 2.72

CEMENT: Ordinary Portland cement of 53 grade and specific gravity was found out to be of 3.15 was used.

Portland pozzolana cement of 43 grade and specific gravity was found out to be of 3.15 was used

Requirements of concrete mix design

The requirements which form the basis of selection and proportioning of mix ingredients are:

a) The minimum compressive strength required from structural consideration
b) The adequate workability necessary for full compaction with the compacting equipment available.
c) Maximum water-cement ratio and/or maximum cement content to give adequate durability for the particular site conditions
d) Maximum cement content to avoid shrinkage cracking due to temperature cycle in mass concrete.

Factors to be considered for mix design

- The grade designation giving the characteristic strength requirement of concrete.
- The type of cement influences the rate of development of compressive strength of concrete.
- Maximum nominal size of aggregates to be used in concrete may be as large as possible within the limits prescribed by IS 456:2000.
- The cement content is to be limited from shrinkage, cracking and creep.
- The workability of concrete for satisfactory placing and compaction is related to the size and shape of section, quantity and spacing of reinforcement and technique used for transportation, placing and compaction.

MIX DESIGN OF M45 WITH OPC CEMENT

- DESIGN STIPULATIONS

Characteristic target mean strength of concrete 53.25Mpa

Max.size of aggregate is 20mm
Degree of workability : 0.8(C.F)
Slump 25mm
Degree of quality control : Good
Type of exposure : severe

- TEST DATA FOR MATERIALS

Specific gravity of cement : 3.15
Specific gravity of fine aggregate : 2.56
Specific gravity of coarse aggregate : 2.72

The following are mix proportions obtained by mix design from I S 456-2000

W	C	f_a	C_a
181.06	532.58	397.14	1266.68
0.34	1	0.745	2.37

MIX DESIGN OF M45 WITH PPC CEMENT

The following are mix proportions obtained by mix design from I S 456-2000 by using P.P.C

W	C	f_a	C_a
181.06	532.58	385	1155.20
0.34	1	0.72	2.16

CONCRETE CASTING

The mixing was done in concretemixer, cubes of size150×150×150mm were cast in C.I.moulds. The beams were casting cast in C.I.moulds of size 150×150×700mm.cylinders were cast in C.I. mould of dia 150mm and height 300mm.

The procedure consists of first weighing the ingredients fine aggregate, coarse aggregate as per the require quantities of concrete and place them in concrete mixer and mix it thoroughly for a few minutes. Then water and admixture as calculated was added

The 9 cubes and 3cylinders were cast with OPC of 53gradde cement
The 9 cubes and 3cylinders were cast with PPC of 43gradde cement

The 9 cubes and 3cylinders were cast with OPC of 53gradde cement using 0.5% of admixture (conplast S.P 430)

The 9 cubes and 3cylinders were cast with OPC of 53gradde cement using 1% of admixture (conplast S.P 430)

SPLIT TENSILE STRENGTH OF CONCRETE:

The test was carried out by placing a cylindrical specimen horizontally between the load surface of a compression testing machine. The load was applied uniformily until failure of the cylinder along the vertical diameter.

The following relation is used to find out the split tensile strength.

$$F_t = 2p/\pi LD$$

Where,

F_t = split tensile strength strength in kg/cm^2 .

P= compressive load on the cylinder in kg.

L= length of the cylinder in cm.

D = dia of the cylinder in cm.

The results have been tabulated and plotted.

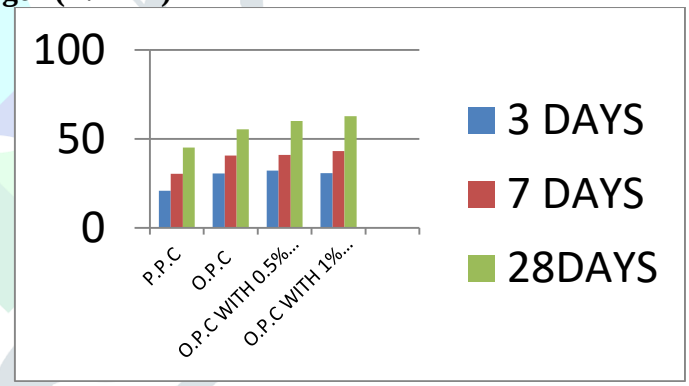
COMPRESSIVE STRENGTH OF CUBE & SPLIT TENSILE TEST



Results :

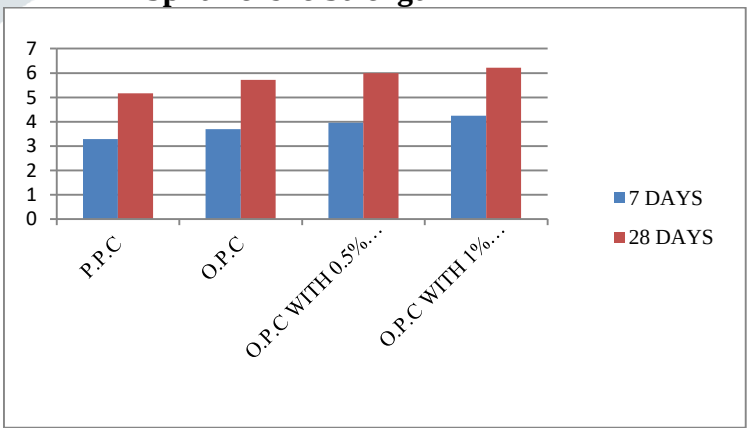
Compression Strength (N/mm^2)

NO. OF DAYS CURING	P.P.C	O.P.C	O.P.C WITH 0.5% ADMIXTURE	O.P.C WITH 1% ADMIXTURE
3 DAYS	20.74	30.51	32.14	30.74
7 DAYS	30.43	40.57	41	43.03



NO. OF DAYS CURING	P.P.C	O.P.C	O.P.C WITH 0.5% ADMIXTURE	O.P.C WITH 1% ADMIXTURE
7 DAYS	3.28	3.69	3.96	4.24
28 DAYS	5.17	5.72	5.80	6.22

Split Tensile Strength



CONCLUSIONS

1. The compressive strength of M45 concrete with PPC is gradually increase with the age of curing.
   a) At the age of 3 days 38% of target mean strength is achieved
   b) At the age of 7 days 57.14% of target mean strength is achieved.
   c) At the age of 28 days 84.84% of target mean strength is achieved.
2. The compressive strength of M45 concrete with OPC cement after curing is:
   a) At the age of 3 days 57.29% of target mean strength is achieved.
   b) At the age of 7 days 76% of target mean strength is achieved.
   c) At the age of 28 days more than target mean strength is achieved.
3. The compressive strength of M45 concrete with OPC cement using 0.5% admixture after curing is:
   a) At the age of 3 days 60% of target mean strength is achieved.
   b) At the age of 7 days 86% of target mean strength is achieved.
   c) At the age of 28 days more than target mean strength is achieved.
4. The compressive strength of M45 concrete with OPC cement using 0.5% admixture after curing is:
   a) At the age of 3 days 61% of target mean strength is achieved.
   b) At the age of 7 days 87% of target mean strength is achieved.
   c) At the age of 28 days more than target mean strength is achieved.
5. It is observed that the compressive strength of concrete with OPC cement is greater than that of PPC cement by 19.10%
6. It is also observed that the compressive strength of concrete with OPC cement with 0.5% of admixture is greater than that of OPC cement by 11.50%
7. It is further observed that the compressive strength of concrete with OPC cement with 1% of admixture is greater than that of OPC cement by 16.44%
8. The split tensile strength of the PPC is less than that of OPC by 10.73%
9. It is observed that tensile strength of OPC cement is less than that of OPC with 0.5% admixture by 7.31%
10. It is observed that tensile strength of OPC cement is less than that of OPC with 1% of admixture by 14.90%
11. The flexural strength of OPC concrete is greater than that of PPC by 10.63%
12. It is observed that the flexural strength of OPC with 0.5% of admixture is greater than that of OPC by 1.39%
13. It is observed that the flexural strength of OPC with 1% of admixture is greater than that of OPC by 7.24%
14. Hence the desire production of M60 concrete is achieved by adding 1% of admixture to M45 concrete.

REFERENCES

1. A text book of concrete technology, theory and practice by M.S. SHETTYs.chand publishers, New Delhi.
2. Concrete mix design from I S 10262 – 1982
3. Methods of test for splitting tensile strength of concrete I S 5816 – 1970.
4. 28 days strength of cement, tested according to I S 4031 – 1968.
5. Indian Standards 456 – 2000: Plain and Reinforced Concrete Code of Practice.
6. Indian Standards 1199 – 1959: Indian standard Methods of Sampling and analysis of concrete. N /mm^2
7. Kong Xiangming, Zhang Yanrong, Hou Shanshan, Study on the rheological properties of portland cement pastes with polycarboxylate superplasticizers,Rheol. Acta. 52 (7) (2013) 707–718.
8. Fali Huang, Huajian Li, Zhonglai Yi, Zhen Wang, Yongjiang Xie, The rheological properties of self-compacting concrete containing superplasticizer and air-entraining agent. Construction and Building Materials 166 (2018) 833–838
9. Fei Sha, Shucai Li, Rentai Liu, Zhaofeng Li, Qingsong Zhang, Experimental study on performance of cement-based grouts admixed with fly ash, bentonite, superplasticizer and water glass. Construction and Building Materials. 161 (2018) 282–291