Ceraplast and Ceraproof Admixtures Behaviour on High Strength Concrete

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***Abstract* — In this paper, a brief practical review is presented on two grades of concrete of which one is medium strength concrete(M_{40})and the other is high strength concrete(M_{60}), containing some mineral and chemical admixtures by mass of the cementitious material. The behavior of specimens cast with medium strength concrete and high strength concrete with and without admixtures are compared with respect to ultimate strength, workability and cracking. Strength improving admixtures such as CERAPLAST-400, CERAPROOF-PXL are applied for concrete mix to develop strength.**

***Keywords*—High strength concrete, Admixtures, Rice husk ash, Super plactizers,**

1. INTRODUCTION

Engineers, Architects and Designers all over the world, have been considering from time to time the use of higher strength concrete in their structures.

The objective of this report is to review the effects of admixtures on concrete properties and provide some guidelines for adopting appropriate concrete admixtures for improving strength. Since strength development concrete is a broad topic, this report only highlights the admixtures to be included in concrete for improving strength. These structures include not only high raised buildings but also dams, bridges. As the admixtures enhance concrete properties in terms of strength, durability and workability, the end product is also suitable for structures exposed to aggressive environments. Strength improving admixtures such as CERAPLAST-400, CERAPROOF-PXL, and RICE HUSK ASH. are applied for concrete mix

2. NEED OF HIGH STRENGTH CONCRETE

To put the concrete in to service at much earlier age for example opening the pavement at 3-days.
To build high-rise buildings by reducing column sizes and increasing available space.
To build the superstructures of long-span bridges and to enhance the durability of bridge decks.

3. DESIGN OF HIGH-STRENGTH CONCRETE MIX

Optimum concrete mix design results from selecting locally available materials that make the fresh concrete placeable and finishable and that ensure the strength development and other desired properties of hardened concrete as specified by the designer. Some of the basic concepts that need to be understood for high strength concrete are:
Aggregates should be strong and durable. They need not necessarily be hard and of high strength but need to be compatible, in terms of stiffness and strength, with the cement paste. Generally smaller maximum size coarse aggregate is used for higher strength concretes. The sand may have to be coarser than that permitted by ASTM C 33 (fineness modulus greater that 3.2) because of the high fines content from the cementitious materials.

High strength concrete mixtures will have a high cementitious materials content that increases the heat hydration and possibly higher shrinkage leading to the potential for cracking. Most mixtures contain one or more supplementary cementitious materials such as fly ash (class c or f), ground granulated blast furnace slag, silica fume, metakaolin or natural pozzolanic materials

High strength concrete mixtures generally need to have a low water-cementitious materials ratio (w/c). W/c ratios can be in the range of 0.23 to 0.35. These low w/c ratios are only attainable with quite large dosage of high range water reducing admixtures (or super plasticizers) conforming to Type F or G by ASTM C 494. A Type A water reducer may be used in combination

The total cementitious material content will be typically around 415 kg/m3 but not more than about 650 kg/m3.
The use of air entrainment in high strength concrete will greatly reduce the strength potential.

4. SALIENT FEATURES OF HIGH STRENGTH CONCRETE

- Compressive strength > 50 MPa, even up to 80 MPa
- Water-binder ratio = 0.25-0.35, therefore very little free water.
- Reduced flocculation of cement grains.
- Wide range of grain sizes.
- Densified cement paste.
- No bleeding homogeneous mix.
- Less capillary porosity.
- Discontinuous pores.

- Stronger transition zone at the interface between cement paste and aggregates.
- Low free lime content.
- Endogenous shrinkage.
- Powerful confinement of aggregates.
- Little micro-cracking until about 65-70% of fck.
- Smooth fracture surface.

5. TESTING OF MATERIALS

In the present investigation the following materials were used.

- Zuari – 43 grade cement conforming to IS: 12269 - 1987
- Fine aggregate and coarse aggregate conforming to IS: 383 - 1970

Admixtures :

- High performance Super plasticizing Admixture CERAPLAST – 400 Conforming to IS: 9103 – 1999.
- Fly Ash Hydration Promoter CERAPROOF–PXL Conforming to IS: 9103 – 1999.

6.1. High Performancesuper Plasticizing Admixture Ceraplast – 400.

- Ceraplast 400 is a high performance, low dosage super plasticizer based on Melamine Formoddedlyde Sulphorate (MFS). Highly recommended for increased early strength of concrete, which is a must for precast and prestressed concrete industries.
- Ceraplast 400 disperses cement particles more rapidly in the concrete mix
- Ceraplast 400 is very advantageous for pre-cast concrete constructions and for concrete sleepers, electric poles and for pre-stressed concrete constructions.
- Ceraplast 400 increases durability of concrete structures Ceraplast 400 is a high performance, low dosage super plasticizer based on Melamine Formoddedlyde Sulphorate (MFS). Highly recommended for increased early strength of concrete, which is a must for precast and prestressed concrete industries.
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- Ceraplast 400 increases durability of concrete structures

(in parentheses). An exception would be the use of English units as identifiers in trade, such as “3.5-inch disk drive”.

- Ceraplast 400 when incorporated into the concrete improves the workability of the concrete without air entrainment due to its excellent dispersion characteristics.

5.1.1. Method Of Use:

Ceraplast 400 is directly added into the mix at the same time as the gauging water. Reduce water dosages for required consistency.

5.1.2. Compressive Strength:

Substantial reduction in the water content i.e. 20% - 25% can result in high early compressive strength for a constant slump. The ultimate compressive strength can be enhanced by upto 25% by proper mix design with ceraplast 400.

5.1.3. Properties:

Supply form	:	liquid
Color	:	Transparent
Specific gravity	:	1.1 + 0.03
Chloride contents	:	Nil

5.1.4. *Recommended Dosage***:**

0.3% to 1.2% ceraplast 400 by weight of cement. Maximum dosage may have to be increased to as high as 2% of cement weight where exceptionally high strength is required. Suitable modifications in the mix design are required in such cases.

6.1. Fly Ash Hydration Promoter Ceraproof – Pxl

Ceraproof PXL is a composite chemical based entirely on inorganic complex compound which accelerates dissolution of glassy phase of both low calcium and high calcium fly ash in solution to react with lime to generate secondary calcium silicate hydrate crystals for development of early strength in pozzolona blended cementitious binders.

Ceraproof PXL can be used economically by the replacement of 70% cement. It is used for the production of high strength PPC concrete and mortar.

5.2.1. PROPERTIES:

Supply form	:	Powder
Color	:	Off White
Chloride contents	:	Nil

5.2.2. recommended dosage:

1 to 5% on weight of fly ash. Actual dose is to be determined by trail.

The Mineral admixtures which we used in this present project

5.2.3. Mix Design For Present Investigation

In the present work the above method has been used to get proportions for high strength concrete.
The concrete mix design for M40 and M60 were carried out according to Indian standard recommendation method IS 10262 – 1982. The calculations are given in Appendix A1 and A2. The proportions are given in Table.1

Table.1 Mix Proportions

S.NO	Targeted strength (MPa)	Mix Proportions
1	40	1:0.73:2.24:0.32
2	60	1:0.51:1.61:0.25

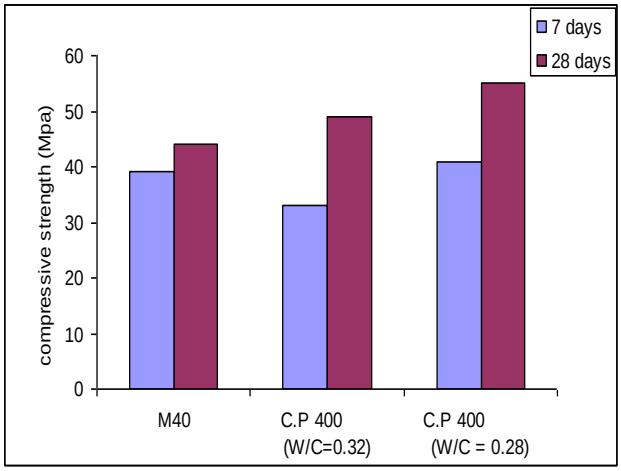
6. TEST RESULTS AND DISCUSSIONS

6.1. Compressive Strength Prediction:

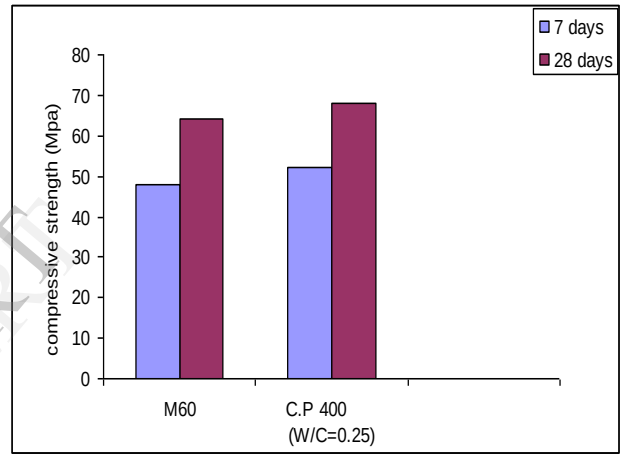
Compression test is the most common test conducted on hardened concrete, partly because it is an easy test to perform, and partly because most of the desirable characteristic properties of concrete are qualitatively related to its compressive strength.
The cube specimen is of the size 15 x 15 x 15 cm. If the largest nominal size of the aggregates does not exceed 20mm, 10cm size cubes may also be used as an alternative. The characteristic compressive strength varies for both medium strength concrete and high strength concrete.

TABLE.2 DATA RECORDED FOR CERAPLAST- 400 DURING THE TEST

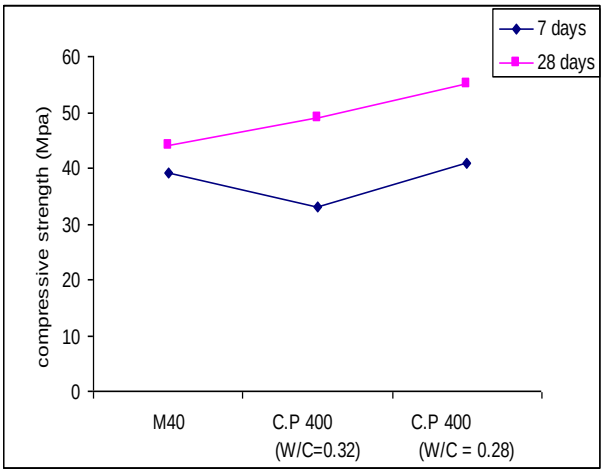
S.NO	Grade of concrete	Workability(Compaction factor)	Compressive strength of 7 days(MPa)	Compressive strength of 28 days(MPa)
1	M-40	0.94	39	44
2	M-40+CERAPLAST 400(W/C = 0.32)	0.98	33	49
3	M-40+CERAPLAST 400(W/C = 0.28)	0.96	41	55
4	M-60	0.9	48	64
5	M-60+CERAPLAST 400	<0.9	52	68



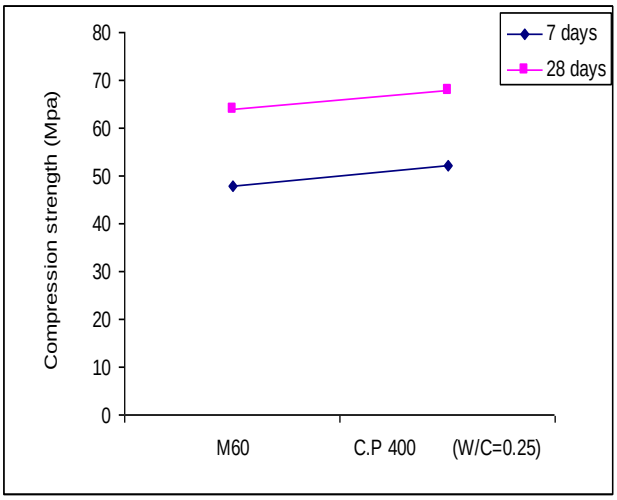
Bar Chart: 1 comparison of compressive strength vs water cement ratio of CERAPLAST- 400 for M_{40}



Bar Chart: 2 comparison of compressive strength vs water cement ratio of CERAPLAST- 400 for M_{60}



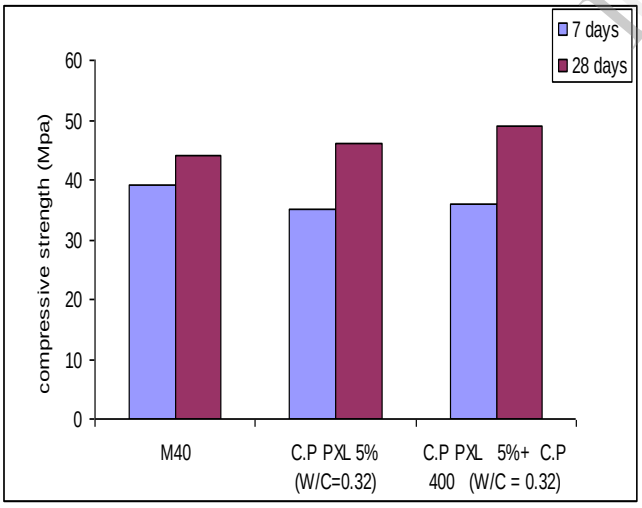
Compressive strength vs w/c ratios CERAPLAST- 400 with M_{40}



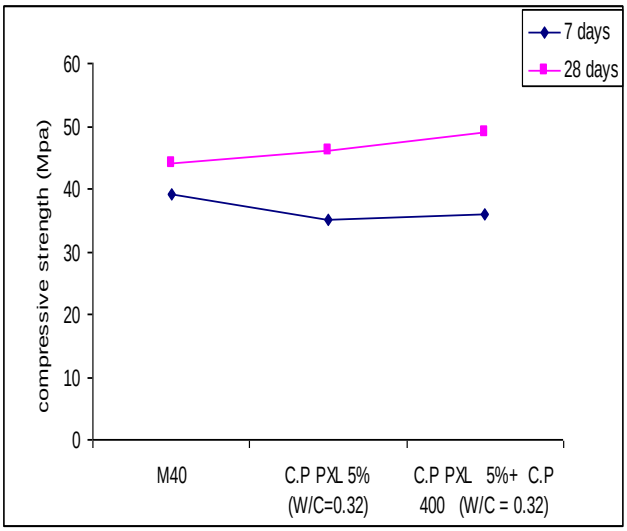
Compressive strength vs w/c ratios
CERAPLAST- 400 with M_{60}

TABLE.3 DATA RECORDED FOR *CERAPROOF- PXL* DURING THE TEST

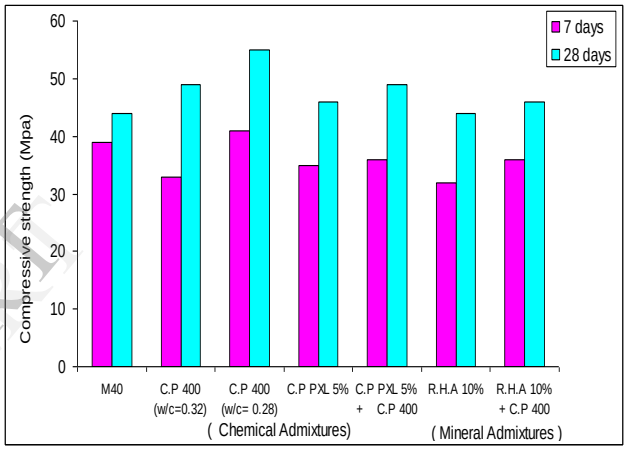
S.NO	Grade of concrete	Workability(Compaction factor)	Compressive strength of 7 days(MPa)	Compressive strength of 28 days(MPa)
1	M-40	0.94	39	44
2	M-40+CERAPROOF PXL(W/C = 0.32)	0.85	35	46
3	M-40+CERAPROOF PXL(W/C = 0.28)	0.89	36	49



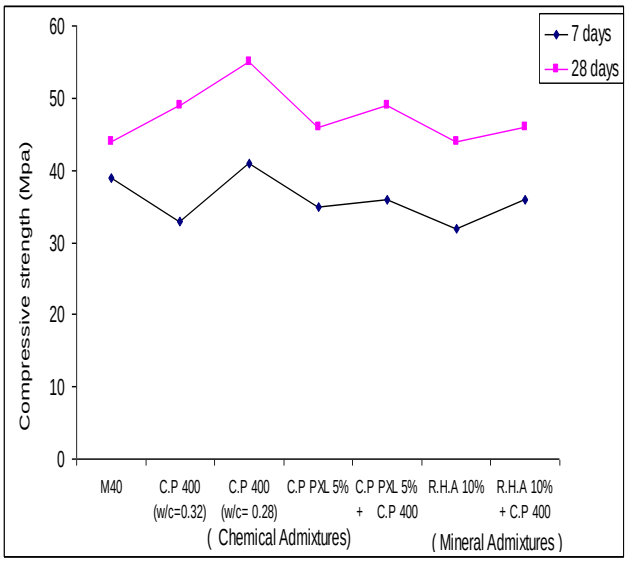
Bar Chart: 3 Comparison of compressive strength vs water cement ratio of CERAPROOF- PXL



Compressive strength vs w/c ratios
(CERAPLAST- PXL with M40)



Bar Chart: 4 Represents the combination of both chemical and mineral admixtures



Compressive strength vs w/c ratios for the combination of chemical and mineral admixtures

7. CONCLUSIONS

- The present paper mainly predicts the medium strength concrete can be safely extended to high strength concrete by adding mineral and chemical admixtures.
- From the present investigation it is observed that the experimental characteristic compressive strength of the cubes is nearly 15% to 20% more, than the medium and high strength concrete cube compressive strength.
- By comparing all the mineral and chemical admixtures which were used in this test, CERAPLAST 400 attains a maximum characteristic compressive strength of 55 MPa for 28 days.

8. SUGGESTIONS FOR FUTURE WORK

- The CERAPLAST 400 (i.e. super plasticizer) can be replaced with hyper super plasticizer which is a water reducer and high strength chemical admixture in market.
- The same investigation can be carried out for different water cement ratios for each chemical and mineral admixture.
- For getting of more strength we can go for the combination of both chemical and mineral admixtures in the desirable dosages. Then the project will be an economical one.

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