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Effect Of Chemical Admixtures On Hardened Properties Of Ordinary Grade Concrete

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Abstract:

The efforts were made to understand the possible differences between plasticizers and super plasticizers. The result of tests conducted on concrete in the presence of plasticizers and superplasticizers. The objective was to observe the change in mechanical properties under the influence of plasticizers and superplasticizers at various dosages level. The result of the treated mix was compared with the control mix (mix without admixture). Observations were made on solid phases of concrete, to note the variation in properties at constant and reduce water cement ratio. From the experience and knowledge gained from this course of study both, plasticizers and super- plasticizers not only improved workability at constant water cement ratio but considerably enhanced the compressive strength at reduce water-cement ratio with slump remaining unchanged, At every stage superplasticizers were known to perform better than plasticizers.

1.General Introduction

Many exciting innovations in material and construction procedures have appeared in last few decades. All round the globe effort are being made to make concrete a more exact material .and introduction to Admixtures has been one of the most notable contribution to concrete technology.

Today efforts are made not only to improve concrete's compressive strength but also durability. Durability has gained worldwide concern because experts believe that the expenditure in rehabilitation and resurrection of concrete structure in near future going to be equal to the expenditure on new construction.

Admixtures are used to change the rheological properties of concrete or mortar to make them suitable for the work at hand, or for economy, or for such other purpose as saving energy. In many instances e.g very high strength, resistance to freezing and thawing, for retardation and acceleration of setting time, an admixture may be that only feasible means of achieving the desired result. In other instances, certain desired objectives may be best achieved by changes in composition of proportion of the concrete mix, if doing so result in greater economy than by using an admixture.

An admixture is defined as 'a material other than water' aggregate and hydraulic cement which might be added to concrete or mortar before or during its mixing to modify one or more properties in fresh and hardened state.

Amongst The different Types of admixtures used, plasticizers and superplasticizers topped the chart. Hence, some effort was made to understand the effect of both plasticizers and superplasticizers in concrete, in a comprehensive manner. Due to certain limitations more stress was laid on understanding the modifications in workability and compressive strength, because a better understanding of their two properties helps us to gauge their effect on other important properties also.

2.Experimental Study

Best efforts were made to understand the effects of different types of plasticizers and superplasticizers. A plasticizer – calcium lignosulphate (CLS) and superplasticizers – sulphonated melamine formaldehyde condensate (SMF) and sulphonated naphthalene formaldehyde condensate (SNF) were used to understand their effect on behavior of concrete and highlight the difference between them if possible.Many times information given by manufactures might appear to be exaggerated. It is quite necessary for a structural engineer to study the quality effects claimed by investigators and manufactures

and then quantify the benefits of plasticizers and superplasticizers to produce a novel and economical design of structural units.The main theme behind conducting the series of experiments was to study the modifications in workability and loss of slump due to the presence of plasticizers and superplasticizers. The control mix of proportion 1:1.67:3:3.33 by mass, obtained by nominal mix design procedure was used which gives normal workability (55 to 60mm at 0.54 water cement ratio) and M20 grade concrete. Different types of water reducing admixtures at different dosage level were used at constant and reduced water cement ratio.In first step the w/c ration was kept constant and CLS, SNF and SMF were applied at different dosage level to observe the change in workability with the help of slump test. In second step the plasticizers and superplasticizers were applied at the same dosage level as before, but the w/c ration was reduced so as to keep the slump constant.Once the positive sign of strength gain started to appear, certain quantity of cement was reduced to understand the effect of reduction of cement content on workability and compressive strength. The sole idea behind reducing cement content was to understand the economic benefits of using WRAs. Concrete in its fresh state with high dosage of superplasticizers showed signs of segregation and bleeding. This prompted to increase sand first to 40% and then to 45% to understand the influence of higher sand content not only on segregation, bleeding and workability but also the compressive strength.

3.Materials Specifications

Ordinary Portland cement, 53 Grades conforming to I.S.269-1967.

River sand ('Goma' sand) passing through is 4.75 mm sieve.

Dried Basalt crushed stones (Kapchi) with maximum size of 20mm.

properties	CLS	SMF	SNF
Specific Gravity	1018 ± 0.01	1.22 ± 0.1	1.22 to 1.225 @ 25 ˚C
Chloride Content	Nil (i.e. less than 0.2%)	Nil	Nil (BS 5075 and IS : 456)
Air entertainment	Less than 2%	Less than 2%	Less than 1%
Self life	12 Months	12 Months	12 Months
Standards	IS: 9103 – 1979	ASTM:C 494	IS: 9103 – 1979, BS: 5.75 - III

Table 1: Properties of Plasticizers

4.Mix Proportioning

Using sand and gravel conforming to IS 383-1979 cubes were casted using mix proportion of 1:1.67:3.33 by weight, which yields M20 grade concrete on 28 days curing. When cement was reduced by 10% the proportion changed to 1:1.86.3.72. With the increase in sand content mix of proportion 1:2.03:303 (40% sand of total aggregate) and 1:2.28 : 2.78 (45% sand of total aggregate) was used. Sample were weighted to an accuracy of 50 grams (0.1% of total weight of batch).

5.Results And Discussion

Another advantage of using plasticizers and super-plasticizers is that at reduced water cement ratio not only compressive strength increases, but also the rate of gain strength increases.The best results of series of experiments conducted with the different types of water reducing admixtures at different dosage levels of dealt separately in this section. The results are represented graphically. The results obtained with and without water reduction are compared with those obtained from control mix.

5.1.Effect Of Calcium Lignosulphates (Cls)

Summary of Effect of Calcium Lignosulphate (Plasticizers) on						
Workability (Slump Test) and Compressive Strength (3, 7,28 Days)						
Proportion (1:1.67:3.33) by weight. Cement factor = 400 kg / m ^{3} appx.						
Admixture dosage %	**3-days strength N/mm ^{2}**	**% inc. in Strength**	**7-days strength N/mm ^{2}**	**% inc. in Strength**	**28-days strength N/mm ^{2}**	**% inc. in Strength**
Control mix	8.4	-	18.4	-	24.6	-
0.3	9	7.1	19.2	4.6	25.1	2
0.45	8.6	2.4	18.7	1.5	24.9	1.2
0.6	8.3	-1.2	18.3	-0.7	24.1	-0.2
0.3	10.6	26.2	22.2	20.3	29.2	18.7
0.45	13.8	64.3	24.1	30.8	31.3	27.2
0.6	16.6	97.6	25.3	37.7	33.4	35.8

Table 2

While using CLS at constant water cement ratio to enhance the workability, certain variation in the compressive strength was noted. (Table 2) However the values moved in a narrow range. From the data collected, it is observed that 0.3% dosage the strength increased and the initial gain in strength (7.1% at 3 days) was greater than the gain in ultimate strength (2.03% at 28 days). With increase in the dosage level to 0.45% obtained from control mix. And at 0.6% dosage level the strength at all ages was less than that obtained from control mix. The retarding effect of lignosulphates can be taken as a possible reason to explain the reduction in compressive strength. The decrease in the compressive strength at 0.6% dosage was less than 5 percent which most of the codes permit. At all dosage trend was noted

[Variation in 3 day strength > variation in 7 day strength > variation in 28 day strength] at all dosages At reduced water cement ration there was appreciable increase in the compressive strength. The 3 day strength improves by 25 to 95%, 7 day strength improved by 20 to 387%, and 28 day strength improved by 18 to 36% with increase in the dosage level the compressive strength increased as greater water reduction was possible i.e.

[Gain in strength at 0.3% > gain strength at 0.45% > gain strength at 0.6%] at all ages.

5.2.Effect Of Sulphonated Melamine Formaldehyde Condensate (Smf)

Summary of Effect of Sulfonated Melamine Formaldehyde Condensate on						
Workability (Slump Test) and Compressive Strength (3, 7,28 Days)						
Proportion (1:1.67:3.33) by weight. Cement factor = 400 kg / m ^{3} appx.						
Admixture dosage %	**3-days strength N/mm ^{2}**	**% inc. in Strength**	**7-days strength N/mm ^{2}**	**% inc. in Strength**	**28-days strength N/mm ^{2}**	**% inc. in Strength**
Control mix	8.4	-	18.4	-	24.6	-
0.50	9.1	8.5	19.2	4.2	25.1	2.1
0.75	8.9	5.8	18.9	2.5	25.0	1
1.00	8.6	2.4	18.6	0.9	24.8	0.1
0.50	20.3	141.9	28.6	55.2	34.8	41.5
0.75	24.3	189.3	31.2	72.5	38.7	57.3
1.00	28.6	240.8	34.2	85.6	41.3	67.9

Table 3

Like CLS, the effect on compressive strength in presence of SMF was studied from two different views – first when water cement ratio was kept and water cement ratio was decreased. When water cement ratio was kept constant the SMF content was increased the strength, but recorded a decreasing trend. (Table 3.0) However the strength at all dosages level was greater than control mix at all ages. Also for a given mix the increase in strength showed following relationship.

[Increasing in 3 day strength > Increasing in 7 day strength > Increasing in 28 day strength] at all dosages When the water cement ratio was reduced there was notable increase in the compressive strength. The 3 day strength improved by 140% to 2340%, 7 day strength improved by 55% to 85% and 28 days strength by 41% to 68%, depending upon the amount of water reduced. With the increase in dosage level, the strength kept on increasing because of greater reduction in water cement ratio i.e.

[Days strength at 0.4% dosage > 3 day strength at 0.6% dosage > 3 day strength at 0.8%] at all dosages Similar trend of results was observed for 7 days and 28 days strength, which was in common with those observed with lignosulphates. However the percentages again in strength decrease with age.

[% gain in 3 days > % gain in 7 days > % gain in 28 days] at all dosages

The maximum gain in ultimate strength was 68.8% with water cement ratio 0.39, at 1.0% dosage level.

5.3.Sulphonated Naphthalene Formaldehyde Condensate (Snf)

Summary of Effect of Sulfonated Naphthalene Formaldehyde Condensate on						
Compressive Strength (3, 7,28 Days)						
Proportion (1:1.67:3.33) by weight. Cement factor = 400 kg / m ^{3} appx.						
Admixture dosage %	**3-days strength N/mm ^{2}**	**% inc. in Strength**	**7-days strength N/mm ^{2}**	**% inc. in Strength**	**28-days strength N/mm ^{2}**	**% inc. in Strength**
Control mix	8.4	-	18.4	-	24.6	-
0.50	9.2	9.5	19.1	5.6	25.3	2.8
0.75	8.8	4.8	18.9	2.6	25.1	2
1.00	8.5	2.4	18.7	1.8	24.7	0.4
0.50	21.9	160.4	30.4	65.3	35.7	45.2
0.75	27.5	227	33.8	63.6	39.8	61.7
1.00	30.5	263.3	36.2	96.2	43.6	77.2

Table 4

The trend result obtained with SNF was no different than those obtained in the presence of SMF. At constant water cement ratio there was hardly any difference between the results obtained by SNF and SMF. However certain changes were noted in result when the advantages of water reduction were exploited. The strength gains at all ages were greater with SNF compared to SMF. The reason can be attributed to greater reduction in w/c ratio with SNF.

Table 4would give a detail picture about the modifications in compressive strength using SNF. The maximum strength gain in strength was 77.23% at 28 days strength at 1.0% dosage level when w/c ratio was reduced to 0.375. In comparison with SMF it was greater by 5.8%.

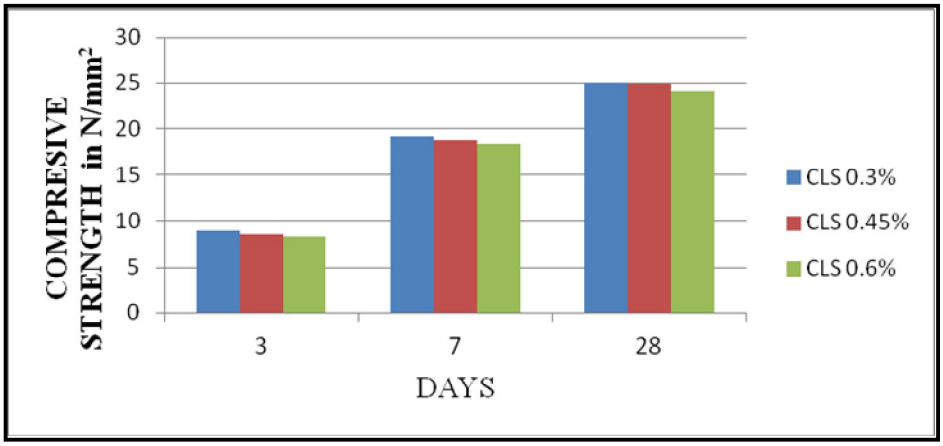

Figure 1:Variation Of Strength With Dosage Of Plasticizer

5.3.1.SomeMore Observations On TheEffect Of Various Wras On Compressive Strength

As expected, at constant water cement ratio certain reduction in strength was observed with CLS which was not the case with SMF or SNF. The results are in line looking to the characteristics of chemical base of the admixtures. At reduced w/c ratio, greater the reduction in w/c ratio higher was the gain. Hence maximum gain was obtained with SNF, Followed by SMF which was gain followed by CLS.

6.Conclusion

There is a marked improvement in the workability of fresh concrete.

The normal slump of 63 mm could be increased to 134 mm using plasticizers (**CLS**) and greater than 190 mm by super plasticizers (SNF and SMF) this apparent rise in workability is a short lived.

Initially the slump loss was very high but the slump of treated concrete at all ages was greater than the control mix. The slump loss was found to be higher for a treated mix than control mix

The slump loss also increases with the increase in the dosage level.

At higher dosage signs of segregation and bleeding were noticed, composition needs to adjust the sand content to take care of this problem.

7.Reference

1. Ramchandran. V. S. Properties Concrete Mixes and Admixtures.
2. Vance Dodson. Concrete admixtures .Structural engineering series. Van Nostrand Reinhold, New York.
3. ACI committee 212, Guide for admixture in concrete, Journal of American concrete institute Vol.68, No -09 Sept.1971.pp 5-41.
4. Banfill P.F.G, a viscometric study of cement pastes containing Super plasticizers notes on experimental techniques.
5. Kumar V, Roy B.N and A.S.R Sai, Effect of Super plasticizers on concrete Indian concrete Journal Vol.68 june1994, pp31-33.
6. Litvan G .G, Air entrainment in presence of Super plasticizers. Journal of American concrete institute Vol.July-august 1983.pp 326-330.
7. Manjrekar S K, Use of Super plasticizers: Myth sand Reality .Indian concrete Journal Vol. 68.june 1994 pp317-320.
8. Neville, A.M., (1995) “Properties of concrete”, Pitman, London, 4ème edition, ISBN0-582-23070-5