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Influence of chemical admixtures on density and slump loss of concrete

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ABSTRACT: *The results of test conducted on concrete in the presence of plasticizers and super plasticizers. The objective was to observe the change in density of concrete & loss of workability under the influence of plasticizers and super plasticizers 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 density 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 density at reduce water-cement ratio however loss in slump observed.*

Key words: *slump loss, density, compressive strength, workability.*

I. GENERAL INTRODUCTION

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 of 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.

Out of 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.

II. EXPERIMENTAL STUDY

Best efforts were made to understand the effects of different types of plasticizers and superplasticizers. A plasticizer – calcium lignosulphate (CLS) and super plasticizers – 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.

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 super plasticizers 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 super plasticizers.

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. Due to its narrow range plasticizers were used at dosage level of 0.3, 0.45, and 0.6 percent by weight cement. But fir superplasticizers, 05, 0.75, 1.0 percent dosage levels were selected looking to their high range of dosage application slump and slump loss at different dosage levels were also observed at different interval of time

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.During the course of investigation the effect of WRA s on slump loss was noted.

III. 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.

Table 1.0 Properties of Plasticizers.

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

IV. 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)

V. RESULTS AND DISCUSSION

5.1 EFFECT ON SLUM LOSS

Maintaining the increased slum is as important as obtaining gain in zero hour slump. Slump test at short intervals were performed to understand the effect of water reducing agent on slum loss. **Table 2.0** shows the comparison of normal concrete with treated concrete.

The most notable observation made was that the rate of slump loss in case of treated concreat was greater than the control mix. With the increased in dosage level not only the slump loss was reported to be higher but the time required to attain zero slump was also increased. Both of the above observations showed pronounced effect with the increased in the dosage level with all type of water reducing admixtures.

The drastic improvement in slump loss was short lived(for few minutes) After first few minutes the slump reduced heavily, at least by 30% to 40% .After this initial period the rate of slump loss was reduced, but was still higher than the control mix.

Result showing the increase in slump at different dosage of water reducing admixtures and after what time the slump equal to zero-hour slump of control concrete was reported is below-

Table 2.0 LOSS OF SLUMP.

WRA type	Dosage level %	Initial slump (mm)	Time after which slump equal to slump of control concrete was reported (min.)
CLS	0.45	117	20
SMF	0.5	163	40
	0.75	175	465
ANF	0.5	179	45
	0.75	190	50

The 60-65 mm slump obtained in case of control mix was obtained even after 20 minutes using CLS and after 40-45 minutes with superplasticizers depending upon the dosage level. With SMF, the time required for zero hour slump increased to 95 and 105 minutes at 0.5 % and 0.75% dosage level compared to 65 minutes in control mix, with SNF the time increased 10 100 and 115 minutes at 0.5% and 0.75% dosage. With CLS the time required for zero slump could be extended from 65 minutes to 90min. From fig.4.29 it can be seen that the slump loss increased in presence of water reducing admixtures and was again higher at higher dosages.

5.2 EFFECT OF DENSITY

Density is a very important parameter as it affects many important properties of concrete including its durability. To understand the effect of water reduction on the density, almost all the cubes were weighed. The weight of the cubes was divided by the volume of moulds used to work out the density. Logically, as the density increases, porosity should reduce giving a durable concrete. All the cubes were weighed after curing to estimate the change in weight after curing. Such observations were noted for control mix and mixes with different water admixtures at different water reducing admixtures as different dosage levels. It was observed that as the water cement ratio was decreased the density of concrete cubes improved. This can be one of the reasons for the increase in the strength of concrete at reduced water cement ratio. For the control mix the average density was reported to be approximately 2700 kg/m3 at water cement ratio 0.54

As the change in density has to do more with the water cement ratio than the type of admixtures, water cement ratio would be taken as a sole variable to explain the change in the density. With the use of water reducing admixtures at the reduced water cement ratio 9with constant slump0, density increased from 2700 to 2745 kg/m3 when the water cement ratio was reduced in the range of 0.42 to 0.44 And when the water cement ration was reduced to 0.4 or less the density improved to 2770 kg/m3 When the cubes were weighed after curing, the weight was reported to be marginally higher. Cubes made from mixes with water cement ratio 0.54 change in the weight was roughly 3.6% When the water cement ratio was reduced to 0.41% 0.44 the change in weight was reduced to 0.8% and at water cement ratio of 0.4 or less the change was low to account (0.12%)

Thus with the decrease in water cement ratio the density increased whilst the change in weight decreased. Once again the use of water reducing admixtures was justified in improving the quality and performance of concrete.

VI. CONCLUSIONS

- 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.
- increase in the dosage level as the water cement ratio required for the given slump decreased, the density of concrete is increased also the percent change in weight of the cubes after curing decreased with reduction in water cement ratio. For maintaining constant slump the reduction in water content for CLS was 5.5% to 14.8%, 20% to 27.7% for SMF and 22.2% to 30.5% for SNF, depending upon the dosage level. There was excessive increase in the compressive strength at reduced water cement ratio.

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