

# Compatibility of Super Plasticizer with OPC 53-S Cement

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**Abstract**— The use of Super Plasticizer in concrete is an important in advancement of concrete technology. Use of Super Plasticizer permits reduction of water to the extent up to 30% without reducing workability. The use of Super Plasticizer is done for the production of flowing, self-leveling, and self-compacting and also for the production of High Strength and High Performance Concrete. OPC53-S special cements are used in the manufacturing of railway sleepers which gives more compressive strength when compared to OPC cements. This special cements are finer than ordinary cements. This project work has been extensively executed to know the compatibility between OPC 53-S Cement and Super Plasticizer and to establish the Optimum dosage of the super plasticizer.

**Key words:** OPC 53-S Cement, Super Plasticizer

## I. INTRODUCTION

Now a days the use of admixtures in structural activity is on the rise. The admixture being the costly component of concrete, finding out the optimum dosage of the Super Plasticizer can reduce the cost of construction. However, the production of concrete is not eco- friendly. In this scenario, the use of readily available Super Plasticizer with optimum dosage can reduce the water content without any change in the strength of the concrete. Reduction in the water content can be greatly achieved with the usage of Super Plasticizer in the concrete. 30% of water can be reduced by using Super Plasticizer.

## II. INCOMPATIBILITY

The word incompatibility refers to the adverse effect on performance of concrete when some cement and superplasticizer are combined. Common problems rises due to incompatibility are flash setting, delayed in setting time, rapid slump loss, improper gain in strength, excessive cracking etc. These issues affect the properties of concrete in hardened state, mainly in strength and durability.

## III. FACTORS AFFECTING COMPATIBILITY

Interaction problems arise due to effect of admixtures on the hydration reaction of cement and due to adsorption of admixture with the cement particles. Compatibility problems may arise when the material selection and design is not proper. Compatibility between cements and super plasticizers is affected by cement composition, admixture type and dosage, concrete mixture proportions etc.

## IV. OPTIMUM DOSAGE OF ADMIXTURE

It is that dosage of admixture, at a given water-binder ratio, till which the performance of the paste increases with the increasing admixture dosage and beyond which the performance remains almost constant. The performance can

be measured using the following experiments and the results are plotted graphically for analysis.

## V. TESTS EMPLOYED

### A. Flow Test

This test is conducted to know the flow behavior of the cement paste made with some dosage of the Super Plasticizer. This dosage is determined from the datasheet provided by the manufacturer of the corresponding Super Plasticizer. According to the dosage suggested by the manufacturers, the range has been increased up to two points and tests have been conducted. The w/c ratio is kept constant throughout the experiment. For the present study the w/c that was considered is 0.35 and 0.4. This should be conducted at controlled condition i.e.  $27 \pm 20^\circ\text{C}$ . Different trails have been done with changing the dosage of the Super Plasticizer to obtain the Optimum Dosage of the Super Plasticizer. Firstly this test is conducted without using Super Plasticizer to compare the flow behavior of that cement with using Super Plasticizer and to know the w/c ratio.

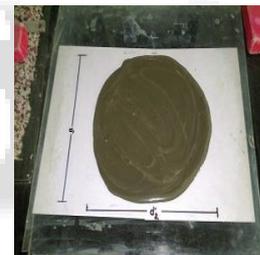


Fig. 1: Flow of cement paste during Flow Test

### B. Penetration Test

Cement paste is subjected for penetration in Vicat apparatus using different types of Super Plasticizer and with different w/c ratios. The depth of penetration is observed for every half an hour interval with different types of Super Plasticizers. This test results helps to know the setting time with respective to that Super Plasticizer. Vicat needle is penetrated into the cement paste for every half an hour interval of time i.e. for 30mins, 60mins, 90mins and 120mins. This procedure is continued with increasing the dosage of Super Plasticizer. The results were observed for two different w/c ratios and Optimum dosage is considered.



Fig. 2: Experimental setup for Penetration Test

### C. Mini-Slump Test

This test is conducted to know the flow behaviour of the cement paste. A cone of 57mm height, 19mm top diameter and 38mm bottom diameter is taken to conduct this experiment. The flow diameter of the cement paste is measured when Super Plasticizer is added to the cement. At the dosage less than the optimum dosage, there will be less flow in the cement paste and at optimum dosage, required flow is observed. Even after increasing the dosage after the optimum value there is no further increase in the flow of the cement paste.

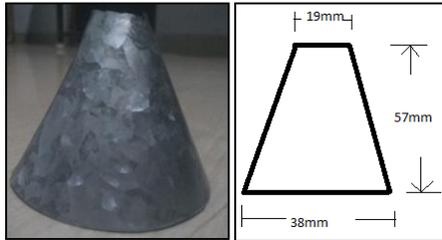


Fig. 3: Equipment for Mini Slump Test

### VI. TEST RESULTS AND CONCLUSIONS

Various brands of PCE based admixtures (Poly Carboxylic Ether) and SNF based admixtures (Sulpho Naptha Formaldehyde) are tested with the above procedures and the results are given below.

- 1) The optimum dosage of the PCE based Super Plasticizer is 0.9% with respect to weight of the cement at 0.35 and 0.4 water-cement ratios.

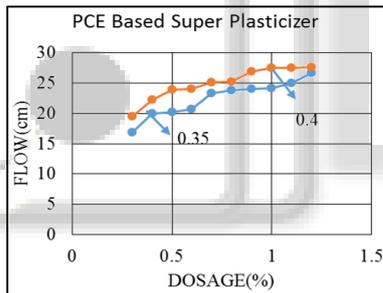


Fig. 4: Flow test for PCE Admixture -1 at 0.35 and 0.4 w/c

- 2) Whereas the optimum dosage of SNF based Super Plasticizer is 1.0% with respect to weight of cement.

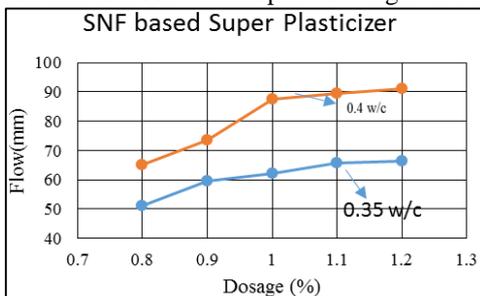


Fig. 5: Mini Slump graph for SNF Admixture -1 at 0.35 and 0.4 w/c

- 3) A graph is plotted between Dosage and diameter of flow for both Flow test and Mini Slump test and it is observed that after reaching the optimum dosage, even with the increase in the dosage of Super Plasticizer there is no significant change in the flow behaviour of the Super Plasticizer.
- 4) For Penetration test, at optimum dosage there is maximum penetration. Due to the over dosage of the

Super Plasticizer there is delay in setting time for PCE 1 Super Plasticizer.

- 5) PCE based Super Plasticizers flows more when compared to SNF based Super Plasticizer when added to OPC 53-S cement.
- 6) Due to the usage of Super Plasticizer, water can be reduced upto 30% than the original requirement of water.
- 7) The over dosage leads to retardation in setting, segregation, and uneconomical usage of Super Plasticizer.
- 8) The low dosage of Super Plasticizer leads to quick loss of fluidity with time.

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