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# STUDIES ON COMPATIBILITY ISSUES OF SUPER PLASTICIZERS WITH OPC 53-S CEMENT

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***Abstract:*** ***The behaviour of the high performance concrete in fresh state can be calculated with the flow behaviour of cement paste made with required dosage of High Range Water Reducer (Super Plasticizer). To know the flow behaviour, Compatibility studies are to be done. This Paper deals with the Compatibility issues between different types of Super Plasticizer coming under PCE and SNF groups with OPC 53-S cement. The Compatibility between Super Plasticizer and OPC 53-S cement can be known by conducting three different types of tests. Flow test, Mini Slump test and Penetration tests are conducted and Compatibility studies are done. From flow test and mini slump test, the flow behaviour of the super plasticizer can be observed. And from the penetration test, the setting time of super plasticizer can be obtained. All the tests conducted above are conducted with varying w/c ratio i.e. 0.35 w/c and 0.40 w/c. The test results also show the variation of the curves with two different w/c ratios. This Paper also mentions the optimum dosage of PCE based Super Plasticizer is 0.9% with respect to the weight of the cement and SNF based Super Plasticizer is 1.0% with respect to weight ofcement.***

***Keywords: Super Plasticizer, Compatibility, Mini slump test, Flow test, Penetration test.***

## I. INTRODUCTION:

The introduction of Super Plasticizer into the concrete helps for the exact flow of concrete in fresh state and for the high strength in the hardened state. This can be achieved with the optimum dosage of the Super Plasticizer because low dosage leads to loss in fluidity and high dosage leads to segregation, set retardation and uneconomical usage of Super Plasticizer. Therefore, a methodology is required to find the Optimum dosage. This Optimum dosage can be obtained from Flow test and Mini slump test. And the setting behaviour can be observed from penetration test. The objective of this paper is to make Compatibility Studies on 6 types of Super Plasticizer with OPC 53-S Cement. And also to find the optimum dosage and Flow behaviour of High Range Water Reducer (Super Plasticizer). A comparison of flow pattern is done between Flow test and Mini slump test is done in this paper. Six types of Super Plasticizers coming under PCE and SNF group are studied in this paper as they exhibit different properties with different cements and at different temperature conditions.

The main advantage of OPC 53-S cement is its high early strength. Due to its high fineness, the setting time is high compared to OPC. Its setting time can be reduced with addition of super plasticizer. The rheology of cement paste due to the effect of super plasticizer is studied along with flow behaviour.(1)The hydration behaviour of different cements at different intervals in presence of super plasticizer is analysed using differential thermal analysis and was concluded that the Portland cement appears to be sensitive with the addition of super plasticizer as the setting time is concerned. (2)The interaction between cement and super plasticizer in concrete is a blend of both physical and chemical mechanisms and are independent. (3)An increase in super plasticizer dosage leads to decrease in the yield stress, plastic viscosity, increase in minimum slump spread up to below saturation point(4).

**Table-1: Physical Properties of OPC 53-S Grade Cements**

| Properties | OPC 53 | OPC 53-S |
|---|---|---|
| Fineness of Cement | 92% | 99% |
| Standard consistency | 32% | 35% |
| Initial setting time | 40 minutes | 62 minutes |
| Final setting time | 330 minutes | 150 minutes |
| Specific gravity | 3.15 | 3.15 |
| Soundness | 2mm | 1mm |

## II. EXPERIMENTAL METHODOLOGY:

**Flow test:** Flow test is conducted to determine the optimum dosage. The procedure of the test method is explained below. The test method is conducted with two different w/c ratios i.e. at 0.35 w/c and 0.40 w/c ratio.400 grams of cement is taken and 70% of required amount of water is added to cement and mixed it thoroughly without having any lumps. Remaining water with dosage of Super Plasticizer is added and stirred it. This paste is poured on a glass plate and let the paste flow freely on it.

**Mini slump test:** A cone of dimension top diameter=19mm, bottom diameter=38mm and height=57mm is taken to conduct this experiment. Cement paste is introduced into the cone and lifted up. The final diameter of the flown paste is noted and a graph is plotted between dosage of the Super Plasticizer and diameter of paste flow.

**Penetration test**: This test conducted similar to Vicat's initial and final setting time. Vicat mould is filled with cement paste and depth of penetration is measured for every 30mins, 60mins, 90mins and 120mins with different dosages of Super Plasticizer.

## III. RESULTS AND DISCUSSIONS:

**A)FLOW TEST:**

**Table -2: Flow test results without using Super Plasticizer**

| Dosage w/c % | Flow (cm) |
|---|---|
| 0.45 | 7.6 |
| 0.5 | 9.9 |
| 0.52 | 10.25 |
| 0.54 | 10.29 |
| 0.55 | 10.65 |
| 0.6 | 15.5 |
| 0.65 | 15.35 |
| 0.7 | 16.4 |

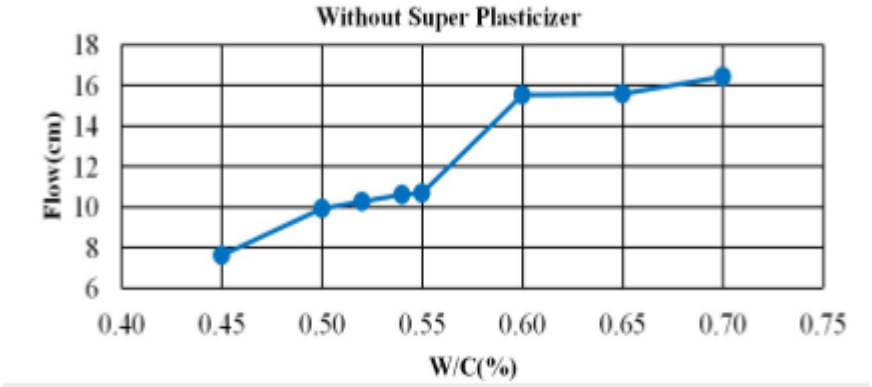


**Fig 1: Flow test with varying w/c ratio and without using Super Plasticizer**

These are test results obtained when flow test is conducted with OPC 53 - S cement using BASF GleniumACE 30. It is a PCE based Super plasticizer. The water - cement ratio is considered are 0.35 and 0.4. The dosage of Super Plasticizer (Master Glenium ACE 30) started from 0.3% to 1.2% with respect to cement.

### I. GLENIUM ACE 30:

Flow of OPC 53 – S cement using master Glenium ACE 30 (BASF) super plasticizer.

**Table -3: Flow test results for ACE Super Plasticizer with 0.35 and 0.4 w/c ratio**

| Dosage of Super Plasticizer (%) | Flow at 0.35 W/C(cm) | Flow at 0.40 W/C(cm) |
|---|---|---|
| 0.3 | 16.9 | 19.4 |
| 0.4 | 20.0 | 22.2 |
| 0.5 | 20.2 | 23.9 |
| 0.6 | 20.7 | 24.0 |
| 0.7 | 23.3 | 25.1 |
| 0.8 | 23.8 | 25.2 |
| 0.9 | 24.0 | 26.9 |
| 1.0 | 24.2 | 27.5 |
| 1.1 | 25.0 | 27.5 |
| 1.2 | 26.7 | 27.6 |

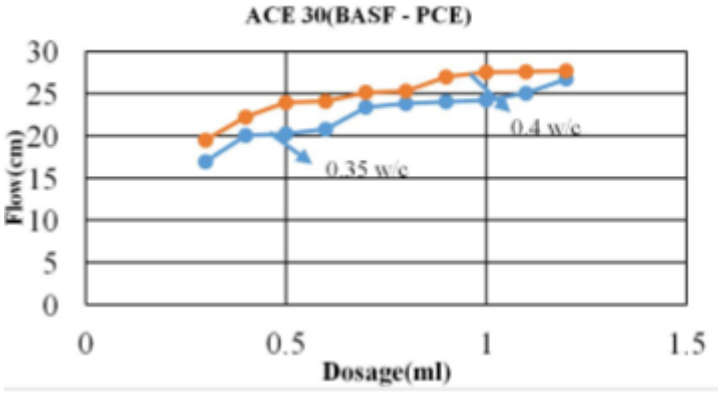


**Fig 2 : Flow test for ACE 30 at 0.35 and 0.4 w/c ratio**

It is observed that, the flow diameter increased significantly up to 0.9% of dosage for both 0.35 w/c ratio and 0.4 w/c ratio. And after 0.9% of dosage, with the increase in dosage of Super Plasticizer there is no significant change in the flow value.

**II. WithMASTERRHEOBUILD 821(BASF):**

These are test results obtained when flow test is conducted with OPC 53 - S cement using BASF Master Rheobuild 821. It is a SNF based Super plasticizer. The water - cement ratio is considered are 0.35 and 0.4. The dosage of Super Plasticizer (Master Glenium ACE 30) started from 0.6% to 1.4% with respect to cement.

**Table -4: Flow test results for Master Rheobuild Super Plasticizer with 0.35 and 0.4 w/c ratio**

| Dosage of Super Plasticizer (%) | Flow at 0.35 W/C(cm) | Flow at 0.40 W/C(cm) |
|---|---|---|
| 0.6 | 07.5 | 10.3 |
| 0.7 | 08.4 | 11.1 |
| 0.8 | 08.9 | 12.5 |
| 0.9 | 08.9 | 13.5 |
| 1.0 | 09.5 | 14.0 |
| 1.1 | 09.7 | 15.0 |
| 1.2 | 11.0 | 16.7 |
| 1.3 | 11.1 | 17.6 |
| 1.4 | 11.8 | 17.9 |

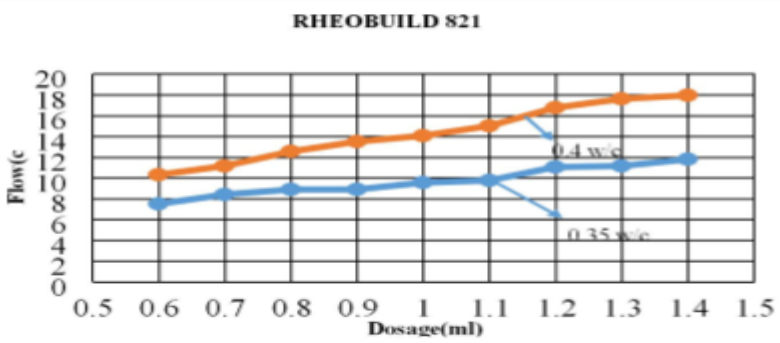


**Fig 3: Flow test for Mater Rheobuild at 0.35 and 0.4 w/c ratio**

It is observed that, the flow diameter increased significantly up to 1% of dosage for both 0.35 w/c ratio and 0.4 w/c ratio. And after 1% of dosage, with the increase in dosage of Super Plasticizer there is no significant change in the flow value. Therefore the **Optimum dosage for Master Rheobuild is 1%** of Super Plasticizer with respect to cement.

### III. CHRYSO Fluid Premia K713:

The dosage of Super Plasticizer (Master Glenium ACE 30) started from 0.2% to 2.2% with respect to cement.

**Table -5: Flow test results fors CHRYSO Fluid Premia K713 Super Plasticizer with 0.35 and 0.4 w/c ratio**

| Dosage of Super Plasticizer (%) | Flow at 0.35 W/C(cm) | Flow at 0.40 W/C(cm) |
|---|---|---|
| 0.2 | 18.8 | 22.6 |
| 0.3 | 19.7 | 25.8 |
| 0.4 | 21.6 | 26.0 |
| 0.5 | 21.9 | 27.1 |
| 0.6 | 24.0 | 27.2 |
| 0.7 | 24.4 | 27.6 |
| 0.8 | 24.9 | 27.6 |
| 0.9 | 25.3 | 28.0 |
| 1.0 | 25.6 | 28.1 |
| 1.1 | 25.7 | 28.6 |
| 1.2 | 26.6 | 28.7 |
| 1.3 | 27.0 | 28.9 |
| 1.4 | 27.2 | 29.2 |
| 1.5 | 27.3 | 29.4 |
| 1.6 | 27.3 | 29.5 |
| 1.7 | 27.7 | 29.8 |
| 1.8 | 27.9 | 30.1 |
| 1.9 | 28.0 | 30.2 |
| 2.0 | 28.2 | 30.5 |
| 2.1 | 28.7 | 30.5 |
| 2.2 | 28.8 | 30.7 |

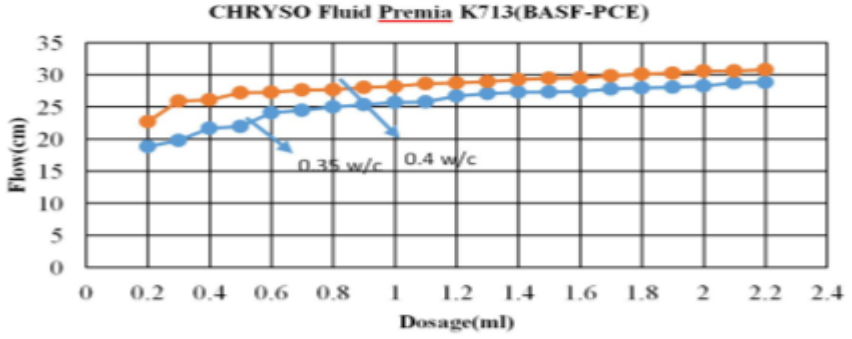


**Fig 4: Flow test for CHRYSO Fluid Premia K713 at 0.35 and 0.4 w/c ratio**

It is observed that, the flow diameter increased significantly up to 0.9% of dosage for both 0.35 w/c ratio and 0.4 w/c ratio. And after 0.9% of dosage, with the increase in dosage of Super Plasticizer there is no significant change in the flow value. Therefore the **Optimum dosage for CHRYSO Fluid Premia K713 is 0.9%** of Super Plasticizer with respect to cement.

## IV. CHRYSO Fluid HP 62210:

The dosage of Super Plasticizer (CHRYSO Fluid HP 62210) started from 0.2% to 2.2% with respect to cement.

**Table -6: Flow test results for CHRYSO Fluid HP 62210Super Plasticizer with 0.35 and 0.4 w/c ratio**

| Dosage of Super Plasticizer (%) | Flow at 0.35 W/C(cm) | Flow at 0.40 W/C(cm) |
|---|---|---|
| 0.2 | 10.0 | 15.4 |
| 0.3 | 12.8 | 16.4 |
| 0.4 | 13.3 | 17.1 |
| 0.5 | 16.6 | 19.0 |
| 0.6 | 19.2 | 22.4 |
| 0.7 | 21.2 | 23.3 |
| 0.8 | 21.3 | 23.8 |
| 0.9 | 22.0 | 24.0 |
| 1.0 | 22.2 | 24.9 |
| 1.1 | 22.8 | 25.2 |
| 1.2 | 23.0 | 25.5 |
| 1.3 | 23.7 | 25.6 |
| 1.4 | 24.2 | 25.9 |
| 1.5 | 24.3 | 26.7 |
| 1.6 | 24.0 | 26.9 |
| 1.7 | 24.5 | 27.1 |
| 1.8 | 24.6 | 27.5 |
| 1.9 | 24.7 | 27.7 |
| 2.0 | 24.8 | 28.0 |
| 2.1 | 25.0 | 28.9 |
| 2.2 | 25.4 | 29.5 |

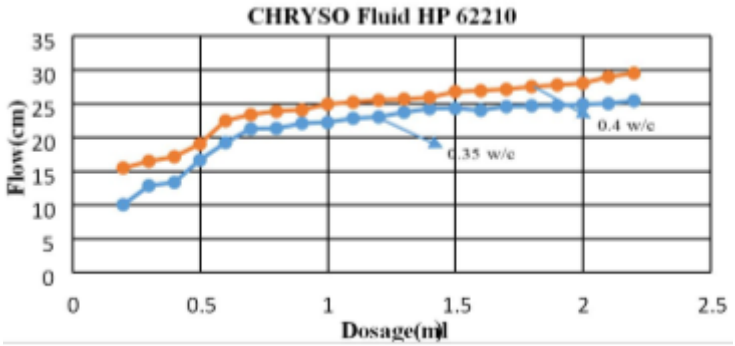


**Fig 5: Flow test for CHRYSO Fluid HP 62210at 0.35 and 0.4 w/c ratio**

It is observed that, the flow diameter increased significantly up to 1% of dosage for both 0.35 w/c ratio and 0.4 w/c ratio. And after 1% of dosage, with the increase in dosage of Super Plasticizer there is no significant change in the flow value. Therefore the **Optimum dosage for CHRYSO Fluid HP 62210 is 1.0%** of Super Plasticizer with respect to cement.

## V. FOSROC Auramix 400(PCE):

These are test results obtained when flow test is conducted with OPC 53 - S cement using FOSROC Auramix. The water - cement ratio considered are 0.35 and 0.4. The dosage of Super Plasticizer (FOSROC Auramix 400) started from 0.3% to 3.2% with respect to cement.

**Table -7: Flow test results for FOSROC Auramix 400 Super Plasticizer with 0.35 and 0.4 w/c ratio**

| Dosage of Super Plasticizer (%) | Flow at 0.35 W/C(cm) | Flow at 0.40 W/C(cm) |
|---|---|---|
| 0.3 | 19.6 | 19.0 |
| 0.4 | 20.5 | 21.8 |
| 0.5 | 21.2 | 22.1 |
| 0.6 | 21.3 | 24.2 |
| 0.7 | 21.4 | 24.4 |
| 0.8 | 23.5 | 24.6 |
| 0.9 | 24.0 | 24.7 |
| 1.0 | 24.1 | 25.3 |
| 1.1 | 24.6 | 25.6 |
| 1.2 | 24.7 | 25.7 |
| 1.3 | 24.8 | 25.8 |
| 1.4 | 24.9 | 25.8 |
| 1.5 | 25.0 | 25.9 |
| 1.6 | 25.7 | 26.1 |
| 1.7 | 25.9 | 26.5 |
| 1.8 | 26.1 | 27.0 |
| 1.9 | 26.4 | 28.0 |
| 2.0 | 26.5 | 28.3 |
| 2.1 | 26.6 | 28.4 |
| 2.2 | 26.6 | 28.4 |
| 2.3 | 26.7 | 28.6 |
| 2.4 | 27.2 | 28.8 |
| 2.5 | 27.4 | 28.9 |
| 2.6 | 27.5 | 28.9 |
| 2.7 | 27.6 | 29.1 |
| 2.8 | 27.6 | 29.2 |
| 2.9 | 27.7 | 29.3 |
| 3.0 | 27.7 | 29.4 |
| 3.1 | 27.9 | 29.5 |
| 3.2 | 28.0 | 29.6 |

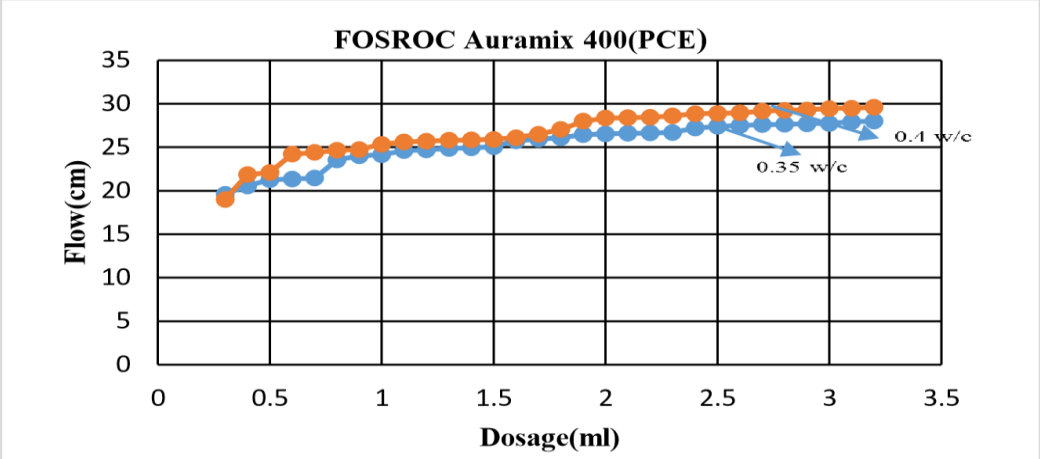


**Fig 6: Flow test for FOSROC Auramix 400 at 0.35 and 0.4 w/c ratio**

It is observed that, the flow diameter increased significantly up to 0.9% of dosage for both 0.35 w/c ratio and 0.4 w/c ratio. And after 0.95% of dosage, with the increase in dosage of Super Plasticizer there is no significant change in the flow value. Therefore the **Optimum dosage for FOSROC Fluid Auromix 400 is 0.9%** of Super Plasticizer with respect to cement.

### VI. FOSROC CONPLAST SP 430KR(M)6:

The dosage of Super Plasticizer Master Glenium ACE 30) started from 0.3% to 1.7% with respect to cement.

**Table -8: Flow test results for FOSROC CONPLAST SP 430KR(M)6 Super Plasticizer with 0.35 and 0.4 w/c ratio**

| Dosage of Super Plasticizer (%) | Flow at 0.35 W/C(cm) | Flow at 0.40 W/C(cm) |
|---|---|---|
| 0.3 | 09.0 | 09.7 |
| 0.4 | 12.0 | 10.2 |
| 0.5 | 14.4 | 11.9 |
| 0.6 | 14.7 | 15.6 |
| 0.7 | 17.4 | 15.8 |
| 0.8 | 20.2 | 18.6 |
| 0.9 | 21.1 | 21.7 |
| 1.0 | 21.6 | 22.8 |
| 1.1 | 21.8 | 23.6 |
| 1.2 | 22.5 | 23.8 |
| 1.3 | 22.7 | 24.1 |
| 1.4 | 23.0 | 24.2 |
| 1.5 | 23.6 | 24.5 |
| 1.6 | 24.3 | 24.9 |
| 1.7 | 24.5 | 25.0 |

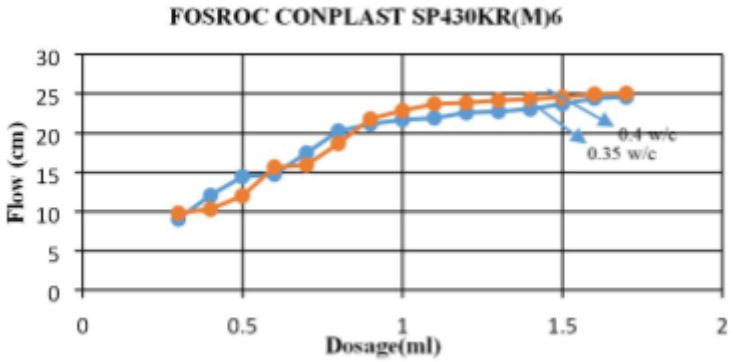


**Fig 7: Flow test for FOSROC CONPLAST SP 430KR (M) 6 at 0.35 and 0.4 w/c ratio**

It is observed that, the flow diameter increased significantly up to 1% of dosage for both 0.35 w/c ratio and 0.4 w/c ratio. And after 1% of dosage, with the increase in dosage of Super Plasticizer there is no significant change in the flow value. Therefore the **Optimum dosage for FOSROC SP 430KR (M) 6 is 1%** of Super Plasticizer with respect to cement.

**B) MINI SLUMP TEST RESULTS:**

### I. Master Glenium ACE30 (PCE)

The dosage started from 0.7% to 1.1% of Super Plasticizer with respect to cement.

**Table -9: Mini Slump results for ACE 30 Super Plasticizer with 0.35 and 0.4 w/c ratio**

| Dosage(%) | Flow(mm) at 0.35 w/c | Flow(mm) at 0.4 w/c |
|---|---|---|
| 0.7 | 56.6 | 59.8 |
| 0.8 | 62.2 | 64.5 |
| 0.9 | 73.5 | 70.8 |
| 1.0 | 79.2 | 76.4 |
| 1.1 | 82.0 | 87.7 |

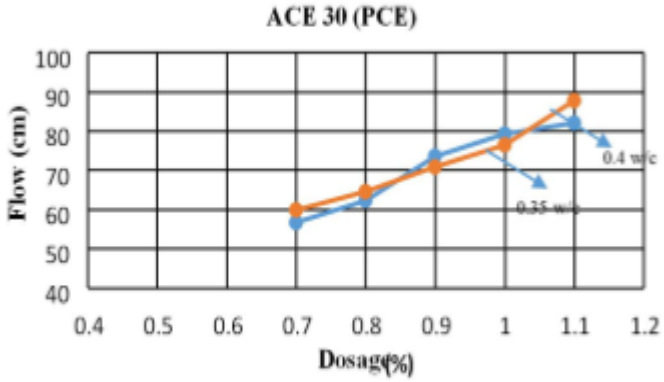


**Fig 8: Mini Slump graph for ACE30 at 0.35 and 0.4 w/c ratio**

**II. Master Rheobuild 821 (SNF)**

The dosage started from 0.8% to 1.2% of Super Plasticizer with respect to cement.

**Table -10: Mini Slump results for Master Rheobuild 821 Super Plasticizer with 0.35 and 0.4 w/c ratio**

| Dosage (%) | FLOW(mm) at 0.35 w/c | FLOW(mm) at 0.40 w/c |
|---|---|---|
| 0.8 | 50.9 | 65.0 |
| 0.9 | 59.4 | 73.5 |
| 1.0 | 62.2 | 87.7 |
| 1.1 | 70.7 | 90.5 |
| 1.2 | 73.5 | 96.2 |

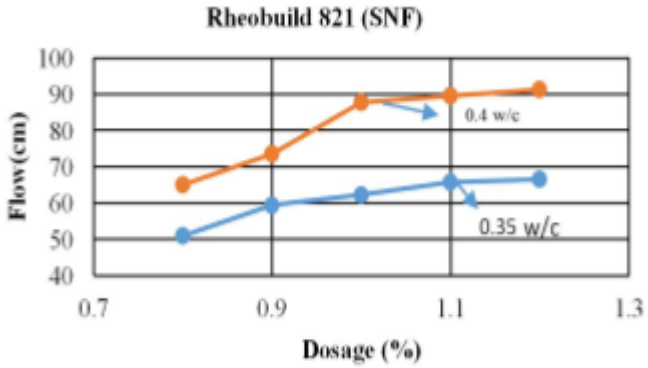


**Fig 9: Mini Slump graph for Master Rheobuild 821 at 0.35 and 0.4 w/c ratio**

From the results, it is observed that there is no increase in flow with the increase in dosage of super plasticizer after optimum dosage.1.0 % is the optimum dosage of Rheobuild 821.Therefore from this test the same optimum dosage is obtained that was obtained in flow test.

III. **CHRYSO Fluid Premia K713 (PCE)**

The dosage started from 0.7% to 1.1% of Super Plasticizer with respect to cement.

**Table -11: Mini Slump results for CHRYSO Fluid Premia K713 Super Plasticizer with 0.35 and 0.4 w/c ratio**

| **Dosage (%)** | **Flow(mm) at 0.35 w/c** | **Flow(mm) at 0.40 w/c** |
|---|---|---|
| 0.7 | 99 | 101.8 |
| 0.8 | 104.7 | 107.5 |
| 0.9 | 107.5 | 110.3 |
| 1.0 | 113.2 | 116.0 |
| 1.1 | 118.8 | 124.5 |

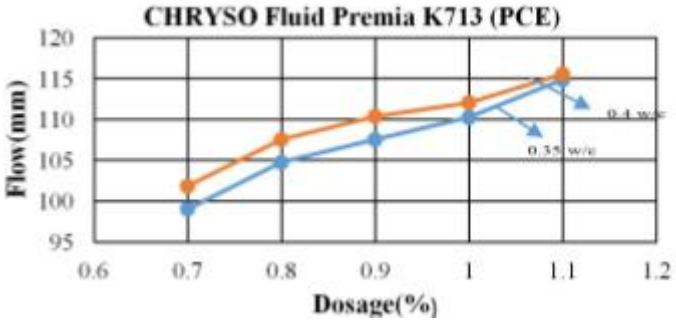


**Fig 10: Mini Slump graph for CHRYSO Fluid Premia K713 at 0.35 and 0.4 w/c ratio**

From the results, it is observed that there is no increase in flow with the increase in dosage of Super Plasticizer after optimum dosage. 0.9 % is the optimum dosage for CHRYSO Fluid Premia K713. Therefore from this test the same optimum dosage is obtained that was obtained in Flow test.

**CHRYSO Fluid HP 62210 (SNF)**

The dosage started from 0.8% to 1.2% of Super Plasticizer with respect to cement.

**Table -12: Mini Slump results for CHRYSO Fluid HP 62210 Super Plasticizer with 0.35 and 0.4 w/cratio**

| Dosage (%) | Flow(mm) at 0.35 w/c | Flow(mm) at 0.40 w/c |
|---|---|---|
| 0.8 | 79.2 | 84.9 |
| 0.9 | 84.9 | 101.8 |
| 1.0 | 93.3 | 107.5 |
| 1.1 | 96.2 | 110.3 |
| 1.2 | 101.8 | 116.0 |

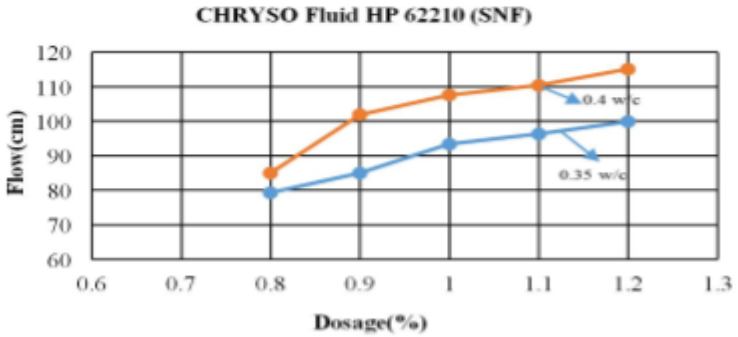


**Fig 11: Mini Slump graph for CHRYSO Fluid HP 62210 at 0.35 and 0.4 w/c ratio**

From the results, it is observed that there is no increase in flow with the increase in dosage of Super Plasticizer after optimum dosage. 1.0 % is the optimum dosage for CHRYSO Fluid HP 62210. Therefore from this test the same optimum dosage is obtained that was obtained in Flow test.

**V. FOSROC Auramix 400 (PCE)**

The dosage started from 0.7% to 1.1% of Super Plasticizer with respect to cement

**Table -13: Mini Slump results for FOSROC Auramix 400 Super Plasticizer with 0.35 and 0.4 w/c ratio**

| Dosage (%) | Flow(mm) at 0.35 w/c | Flow(mm) at 0.40 w/c |
|---|---|---|
| 0.7 | 101.8 | 113.2 |
| 0.8 | 107.5 | 118.8 |
| 0.9 | 116.0 | 121.6 |
| 1.0 | 121.6 | 124.5 |
| 1.1 | 124.5 | 130.1 |

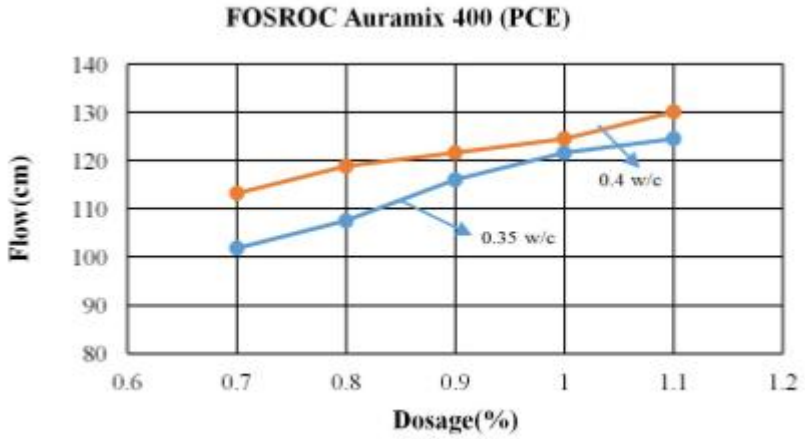


**Fig 12: Mini Slump graph for FOSROC Auramix 400 at 0.35 and 0.4 w/c ratio**

From the results, it is observed that there is no increase in flow with the increase in dosage of Super Plasticizer after optimum dosage. 0.9% is the optimum dosage for FOSROC Auramix 400. Therefore from this test the same optimum dosage is obtained that was obtained in Flow test.

**VI. FOSROC CONPLAST SP 430 KRM 6 (SNF)**

The dosage started from 0.8% to 1.2% of Super Plasticizer with respect to cement.

**Table -14: Mini Slump results for FOSROC CONPLAST SP 430 KRM 6 Super Plasticizer with 0.35 and 0.4 w/c ratio**

| Dosage (%) | Flow(mm) at 0.35 w/c | Flow(mm) at 0.40 w/c |
|---|---|---|
| 0.8 | 67.9 | 82.0 |
| 0.9 | 73.5 | 96.2 |
| 1.0 | 87.7 | 107.5 |
| 1.1 | 93.3 | 110.3 |
| 1.2 | 99.0 | 106.0 |

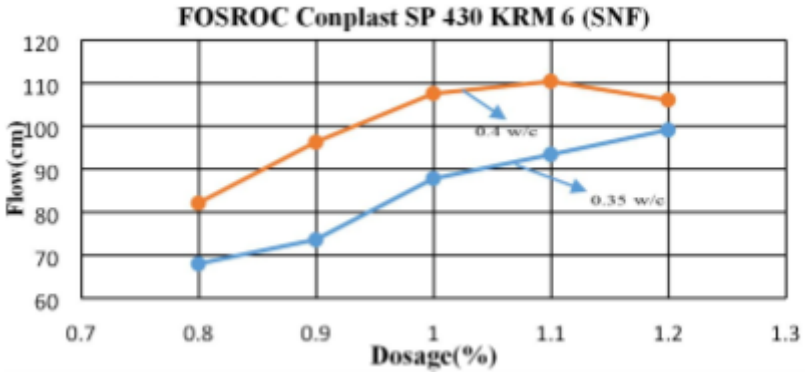


**Fig 13: Mini Slump graph for FOSROC CONPLAST SP 430 KR(M) 6 at 0.35 and 0.4 w/c ratio**

From the results, it is observed that there is no increase in flow with the increase in dosage of Super Plasticizer after optimum dosage. 1.0 % is the optimum dosage for FOSROC CONPLAST SP 430 KRM 6. Therefore from this test the same optimum dosage is obtained that was obtained in Flow test.

**C)Penetration Test Results:**

This test is conducted to know the setting time of cement paste. This test is conducted for every 30 minutes of interval.

**I. Master Glenium ACE 30 (PCE)** at 0.35 w/c and 0.4 w/c ratio

Penetration test is conducted by considering Master Glenium ACE 30 from 0.7% to 1.1 % dosage of Super Plasticizer with respect to cement.

**Table-15: Penetration values in mm**

| Dosage | 30mins | | 60mins | | 90mins | | 120mins | |
|---|---|---|---|---|---|---|---|---|
| | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c |
| 0.7 | -- | 2 | 2 | 8 | 4 | 9 | 8 | 14 |
| 0.8 | 1 | 3 | 3 | 5 | 5 | 8 | 8 | 16 |
| 0.9 | 10 | 1 | 16 | 2 | 20 | 10 | 25 | 15 |
| 1.0 | 2 | 2 | 10 | 6 | 18 | 8 | 26 | 17 |
| 1.1 | 3 | 1 | 15 | 8 | 22 | 10 | 27 | 18 |

At 0.35 w/c, it is observed that at 0.9% dosage of Super Plasticizer maximum penetration is observed. Even after the increase in the dosage of Super Plasticizer, there is no significant increase in the penetration .At 0.4 w/c ratio, the same observation is done as with 0.35 w/c ratio. At 0.9% of dosage maximum penetration is observed.Therefore 0.9% is the optimum dosage for Master Glenium ACE 30 is justified. Since it is a PCE based Super Plasticizer, there will be more amount of fluidity for less amount of Super Plasticizer dosage.

**II.Master Rheobuild 821 (SNF)** at 0.35 w/c and 0.4 w/c ratio
Penetration test is conducted by considering Master Rheobuild 821 from 0.8% to 1.2 % dosage of Super Plasticizer with respect to cement.

**Table-16: Penetration values in mm**

| Dosage | 30mins | | 60mins | | 90mins | | 120mins | |
|---|---|---|---|---|---|---|---|---|
| | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c |
| 0.8 | 2 | -- | 8 | 1 | 20 | 4 | 21 | 5 |
| 0.9 | 6 | -- | 22 | 2 | 24 | 5 | 25 | 8 |
| 1.0 | 8 | 2 | 15 | 4 | 20 | 6 | 26 | 10 |
| 1.1 | 2 | -- | 18 | 2 | 22 | 8 | 27 | 11 |
| 1.2 | 1 | 3 | 4 | 7 | 23 | 10 | 29 | 13 |

At 0.35 w/c, it is observed that at 1.0% dosage of Super Plasticizer maximum penetration is observed. Even after the increase in the dosage of Super Plasticizer, there is no significant increase in the penetration. At 0.4 w/c ratio, the same observation is done as with 0.35 w/c ratio. At 1.0% of dosage maximum penetration is observed.Therefore 1.0% is the optimum dosage for Master Glenium ACE 30 is justified. Since it is a SNF based Super Plasticizer, there will be more amount of fluidity for less amount of Super Plasticizer dosage.

**III.Chryso Fluid Premia K713 (PCE)** at 0.35 w/c and 0.4 w/c ratio
Penetration test is conducted by considering Chryso Fluid Premia K713 (PC**E)**from 0.7% to 1.1 % dosage of Super Plasticizer with respect to cement.

**Table-17: Penetration values in mm**

| Dosage | 30mins | | 60mins | | 90mins | | 120mins | |
|---|---|---|---|---|---|---|---|---|
| | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c |
| 0.7 | 2 | 1 | 6 | 3 | 16 | 5 | 20 | 10 |
| 0.8 | 10 | 2 | 12 | 4 | 18 | 6 | 21 | 11 |
| 0.9 | 6 | 5 | 8 | 10 | 10 | 18 | 20 | 22 |
| 1.0 | 8 | 6 | 10 | 9 | 12 | 12 | 15 | 15 |
| 1.1 | 7 | 8 | 12 | 10 | 16 | 14 | 18 | 18 |

At 0.35 w/c, it is observed that at 0.9% dosage of Super Plasticizer maximum penetration is observed. Even after the increase in the dosage of Super Plasticizer, there is no significant increase in the penetration. At 0.4 w/c ratio, the same observation is done as with 0.35 w/c ratio. At 0.9% of dosage maximum penetration is observed.Therefore 0.9% is the optimum dosage for CHRYSO Fluid Premia K713 is justified. Since it is a PCE based Super Plasticizer, there will be more amount of fluidity for less amount of Super Plasticizer dosage.

**IV.CHRYSO Fluid HP 62210 (SNF)** at 0.35 w/c and 0.4 w/c ratio

**Table-18: Penetration values in mm**

| Dosage | 30mins | | 60mins | | 90mins | | 120mins | |
|---|---|---|---|---|---|---|---|---|
| | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c |
| 0.8 | -- | -- | 4 | 1 | 7 | 3 | 10 | 12 |
| 0.9 | 2 | 2 | 8 | 4 | 12 | 5 | 13 | 14 |
| 1.0 | 1 | 5 | 5 | 11 | 9 | 14 | 15 | 20 |
| 1.1 | 3 | 6 | 6 | 15 | 18 | 17 | 22 | 22 |
| 1.2 | 4 | 8 | 7 | 17 | 20 | 20 | 25 | 25 |

At 0.35 w/c, it is observed that at 1.0% dosage of Super Plasticizer maximum penetration is observed. Even after the increase in the dosage of Super Plasticizer, there is no significant increase in the penetration.At 0.4 w/c ratio, the same observation is done as with 0.35 w/c ratio. At 0.9% of dosage maximum penetration is observed.

Therefore 1.0% is the optimum dosage for Master Glenium ACE 30 is justified. Since it is a SNF based Super Plasticizer, there will be more amount of fluidity for less amount of Super Plasticizer dosage.

**V.FOSROC Auramix 400 (PCE)** at 0.35 w/c and 0.4 w/c ratio

Penetration test is conducted by considering FOSROC Auramix 400 from 0.7% to 1.1 % dosage of Super Plasticizer with respect to cement.

**Table-19: Penetration values in mm**

| Dosage | 30mins | | 60mins | | 90mins | | 120mins | |
|---|---|---|---|---|---|---|---|---|
| | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c |
| 0.7 | -- | -- | 1 | -- | 2 | 1 | 4 | 3 |
| 0.8 | 1 | -- | 2 | 2 | 3 | 3 | 6 | 5 |
| 0.9 | 2 | 3 | 3 | 5 | 5 | 10 | 10 | 13 |
| 1.0 | 2 | 5 | 3 | 8 | 6 | 12 | 12 | 15 |
| 1.1 | 3 | 3 | 5 | 5 | 10 | 7 | 15 | 17 |

**VI. FOSROC CONPLAST SP 430 KRM 6 (SNF)** at 0.35 w/c and 0.40w/c ratio

Penetration test is conducted by considering FOSROC CONPLAST SP 430KRM 6 from 0.8% to 1.2 % dosage of Super Plasticizer with respect to cement.

**Table-20: Penetration values in mm**

| Dosage | 30mins | | 60mins | | 90mins | | 120mins | |
|---|---|---|---|---|---|---|---|---|
| | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c | 0.35 w/c | 0.4 w/c |
| 0.7 | 1 | -- | 3 | 1 | 18 | 10 | 22 | 16 |
| 0.8 | 3 | 4 | 4 | 9 | 20 | 12 | 24 | 22 |
| 0.9 | 15 | 6 | 18 | 8 | 20 | 14 | 25 | 26 |
| 1.0 | 10 | 5 | 13 | 10 | 18 | 19 | 26 | 30 |
| 1.1 | 12 | 8 | 15 | 14 | 19 | 23 | 27 | 32 |

At 0.35 w/c, it is observed that at 1.0% dosage of Super Plasticizer maximum penetration is observed. Even after the increase in the dosage of Super Plasticizer, there is no significant increase in the penetration. At 0.4 w/c ratio, the same observation is done as with 0.35 w/c ratio. At 0.9% of dosage maximum penetration is observed.Therefore 1.0 % is the optimum dosage for FOSROC CONPLAST SP 430 KRM 6 is justified. Since it is a SNF based Super Plasticizer, there will be more amount of fluidity for less amount of Super Plasticizer dosage.

## IV. CONCLUSIONS

- The optimum dosage of the PCE based Super Plasticizer is 0.9% with respect to weight of the cement.
- Whereas the optimum dosage of SNF based Super Plasticizer is 1.0% with respect to weight of cement.
- 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.

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

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