

# Compatibility study of slag cement with PCE based admixtures

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**Abstract** - Admixture-Cement interaction in concrete is a complex blend of chemical and physical mechanism that are independent. Every admixture at optimum dosage gives better results when used with cement. The proposed research work is aimed at testing compatibility of slag cement at different dosages with PCE based admixtures. It was found that The Combination 80% Cement With 20% GGBS Are More Compatible Compared To All The Optimum Dosage Combinations.

**Key Words:** GGBS, PCE based admixture, Compatibility

## 1. Literature Review

**M.M.Alonso (1)** studied the effect of the structural differences in Polycarboxylate and Polyether admixtures on the rheological properties of cement pastes with different chemical and mineralogical compositions and different active additions. It was observed that the cement pastes which contained granulated blast furnace slag showed the highest rises in flowability.

**M.K.Maroliya (2)** studied the change in ingredients contents of concrete like sand and cement under the influence of plasticizers and superplasticizers at various dosages level. It was also observed that plasticizers enhanced the compressive strength at reduced water-cement ratio in addition to improved workability at constant water cement ratio. Reduction in cement content was achieved with increase in sand content to overcome bleeding and segregation.

**S.Sheela(3)** studied the workability and strength behavior of superplasticized concrete and conventional concrete both in fresh and hardened states. It was also observed that the use of superplasticizer can increase the workability and strength without increasing the water cement ratio. It was also concluded that non destructive testing values were in good agreement with the strength behavior of superplasticized concrete for destructive testing.

**Janardhana Maganti and V.Silva Prasada Raju(4)** studied compatibility of Sulphonated Naphthalene Formaldehyde and Lignosulphonates based superplasticizer with Portland slag cements. It was observed that the different brands of cements behaved differently even if the coarse and fine aggregates, water

and family of chemical admixture and the method of concrete mix design were kept constant.

## 2. OBJECTIVE

- Study of characteristics of different series of cement mixes (double blended) with PCE based admixtures
- Determination of optimum dosage of chemical admixtures for OPC and blended cements at various replacement percentages of mineral admixtures
- Determination of flow characteristics with time for various combinations of OPC, GGBS and chemical admixtures.

## 3. MATERIALS USED

- **Cement:** Ordinary Portland Cement (OPC),
- GGBS
- **Chemical Admixtures:** Polycarboxylic acid based.
- **Fine Aggregates:** Manufactured sand
- **Water:** Potable water
- **Coarse Aggregates**

## 4. METHODOLOGY

- Study on properties of different types of blended cement and cementitious materials.
- Study on flow time and optimum dosage of chemical admixtures using Marsh Cone Apparatus
- Study on loss of fluidity with time using Marsh Cone Apparatus.

## 5. EXPERIMENTAL WORK

### ❖ STUDY ON PROPERTIES OF INGREDIENTS

#### ➤ Cement:

The following tests have been carried out for the OPC

- Specific gravity test
- Fineness of cement
- Mineral admixture(GGBS)
  - Specific Gravity test has been carried out for GGBS
- Chemical Admixtures
  - Specific Gravity test has been carried out for Chemical Admixture
- ❖ Study on flow time(Marsh Cone Test)

The test is carried to check the flow time for 1000 ml of cement paste to completely pass through nozzle of the Marsh cone is determined for various dosages of chemical admixture and for various percentages of cement replacement by GGBS.

- ❖ Preparation of cement paste
- Cement paste of 1200 ml is prepared by taking w/c cement ratio as 0.5.
- 70% of mixing water is added with cement initially
- For remaining water , required dosage of chemical admixture is added and left for 2 minutes.
- Mix the paste for 2 minutes at same speed



❖ **Study on properties of ingredients**

**Cement:**

The following tests have been carried out for the OPC

- Specific gravity test
- Fineness of cement

**Mineral admixture(Fly ash)**

Specific Gravity test has been carried out for Fly Ash

**Chemical Admixtures**

Specific Gravity test has been carried out for Chemical Admixture

❖ **Study on flow time(Marsh Cone Test)**

The test is carried to check the flow time for 1000 ml of cement paste to completely pass through nozzle of the Marsh cone is determined for various dosages of chemical admixture and for various percentages of cement replacement by Fly ash.

**Preparation of cement paste**

- Cement paste of 1200 ml is prepared by keeping the w/c cement ratio of 0.5.
- Mixing is done for 4 minutes in the mortar mixer(2 minutes at high speed and 2 minutes at low speed).

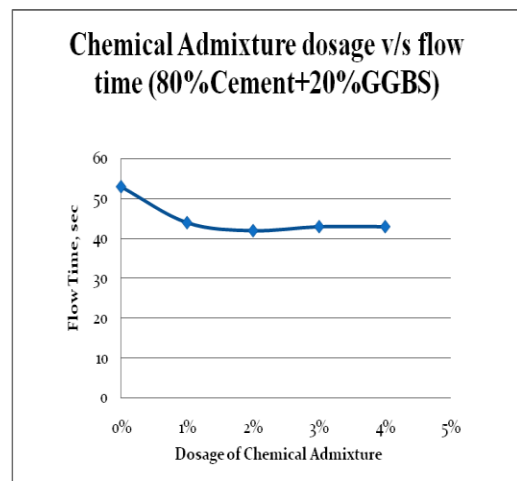
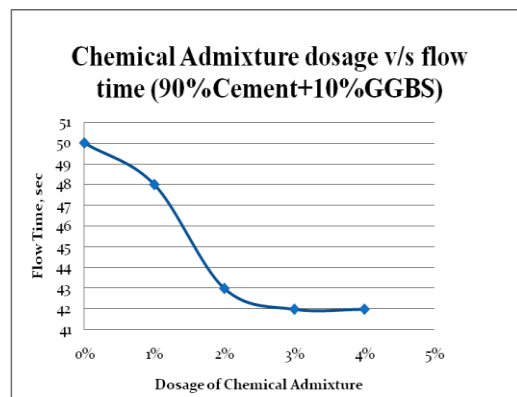
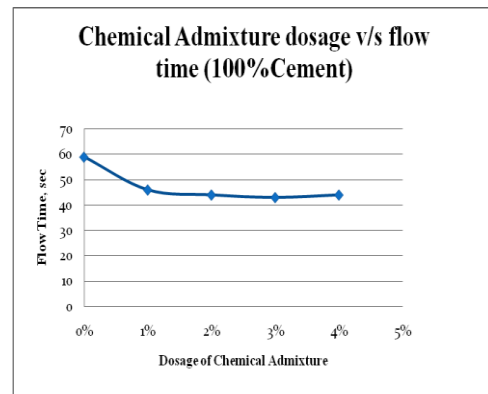
**6.RESULTS**

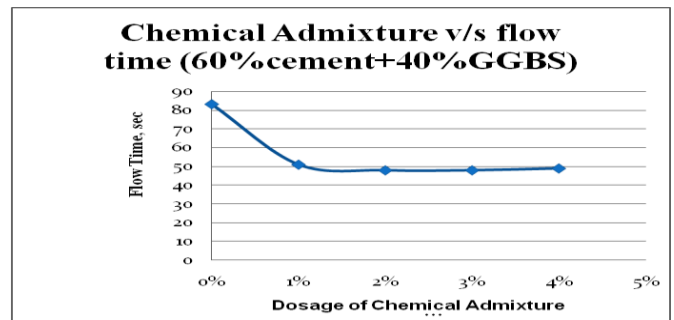
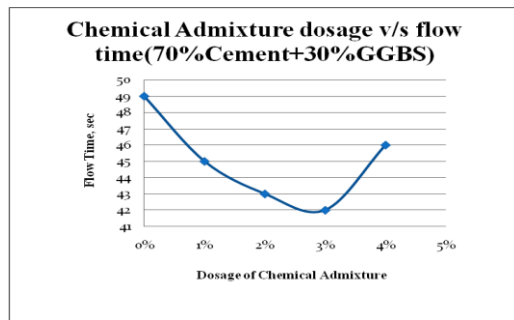
**TEST ON INGREDIENTS**

**Specific Gravity**

SL NO	MATERIAL	SPECIFIC GRAVITY
1	Cement(OPC)	3.05
2	GGBS	2.95
3	Chemical Admixture	1.07

**GRAPHS OF FLOW TIME TEST**





**TESTS ON CEMENT PASTE(Flow Time Test)**

Sl. No	Cement Content, grams	GGBS, grams	W/C ratio	Water Content, ml	Chemical Admixture Dosage in %	Chemical Admixture Content, ml	Flow Time , Sec
<b>100% OPC</b>							
1							
2	1414	-	0.5	707	1%	13	46
3	1400	-	0.5	700	2%	26	44
4	1384.5	-	0.5	693	3%	39	43
5	1369.3	-	0.5	685	4%	51.1	44
<b>90% OPC+10%GGBS</b>							
1	1287.27	143.03	0.5	715.15	0%	-	50
2	1273.09	141.46	0.5	707.28	1%	13.22	48
3	1259.22	139.91	0.5	699.57	2%	26.15	43
4	1245.65	138.41	0.5	692.03	3%	38.81	42
5	1232.36	136.93	0.5	684.62	4%	54.77	42
<b>80%OPC + 20% GGBS</b>							
1	1144.24	286.06	0.5	715.15	0%	-	53
2	1131.64	282.91	0.5	707.28	1%	13.22	44
3	1119.3	279.82	0.5	699.57	2%	26.15	42
4	1107.24	276.81	0.5	692.03	3%	38.81	43
5	1095.43	273.86	0.5	684.65	4%	54.77	43
<b>70% OPC+30% GGBS</b>							
1	1001.21	429.28	0.5	715.15	0%	-	49
2	990.18	424.37	0.5	707.28	1%	13.22	45
3	979.39	419.74	0.5	699.57	2%	26.15	43
4	968.84	415.22	0.5	692.03	3%	38.81	42
5	958.40	410.79	0.5	684.65	4%	54.77	46
<b>60%OPC+40% GGBS</b>							
1	858.18	572.12	0.5	715.15	0%	-	83
2	848.73	565.77	0.5	707.28	1%	13.22	51
3	839.478	559.65	0.5	699.57	2%	26.15	48
4	830.43	553.62	0.5	692.03	3%	38.81	48
5	821.57	547.72	0.5	684.65	4%	54.77	49

**COMPRESSIVE STRENGTH TEST  
MIX DESIGN OF MORTAR BLOCKS :  
[MORTAR 1:4]**

Type of the cement : OPC 53 grade cement

Mix	Proportions	Cement (Gms)	Flyash (Gms)	Fine Aggregates (Gms)	Normal consistency
M	OPC	173.47	-	693.88	0.32
M1	90%CEMENT + 10%GGBS	173.26	19.25	770.04	0.30
M2	80%CEMENT + 20%GGBS	152.54	38.13	762.23	0.32
M3	70%CEMENT + 30%GGBS	132.21	56.66	755.46	0.33
M4	60%CEMENT + 40%GGBS	114.40	76.27	762.68	0.33

**Compressive strength of mortar blocks(1:4)**

Mix	Combinations For Different Specimen	Designation	Weight Of Specimen	Average Compressive Strength 3days(N/Mm <sup>2</sup> )	Average Compressive Strength 7days(N/Mm <sup>2</sup> )
M	100%OPC	778		54	100%OPC
M1	90%CEMENT + 10%GGBS	785		20.4	90%CEMENT + 10%GGBS
M2	80%CEMENT + 20%GGBS	786		19.2	80%CEMENT + 20%GGBS
M3	70%CEMENT + 30%GGBS	820		18.63	70%CEMENT + 30%GGBS
M4	60%CEMENT + 40%GGBS	759		14.2	60%CEMENT + 40%GGBS

**MIX DESIGN OF MORTAR BLOCKS**

**[MORTAR 1:6]** Type of the cement: OPC 53 grade cement

Mix	Proportions	Cement (Gms)	Flyash (Gms)	Fine Aggregates (Gms)	Normal Consistency
M	OPC	143.00	-	693.88	
M1	90%CEMENT + 10%GGBS	128.69	14.29	857.94	0.3
M2	80%CEMENT + 20%GGBS	114.39	28.13	857.94	0.32
M3	70%CEMENT + 30%GGBS	98.68	42.39	845.88	0.33
M4	60%CEMENT + 40%GGBS	85.18	56.79	851.88	0.33

**COMPRESSIVE STRENGTH OF MORTAR BLOCKS (1:6)**

Mix	Combinations For Different Specimen	Weight Of Specimen	Average Compressive Strength 3days(N/Mm <sup>2</sup> )	Average Compressive Strength 7days(N/Mm <sup>2</sup> )
M	100%OPC	778	3.24	100%OPC
M1	90%CEMENT + 10%GGBS	773	5.08	90%CEMENT + 10%GGBS
M2	80%CEMENT + 20%GGBS	768	5.28	80%CEMENT + 20%GGBS
M3	70%CEMENT + 30%GGBS	784	5.32	70%CEMENT + 30%GGBS
M4	60%CEMENT + 40%GGBS	795	5.82	60%CEMENT + 40%GGBS

**7.CONCLUSION**

- The Combination 80% Cement With 20% GGBS Are More Compatible Compared To All The Optimum Dosage Combinations.
- Optimum Dosage Of Chemical Admixtures(PCE Based) For Various Combinations Of Cement And Mineral Admixtures Is Around 3%.
- Time Of Flow Increases With 0 , 10 ,20 , 30 ,45 , 90 Mins For All Types Of Optimum Dosage Combination.

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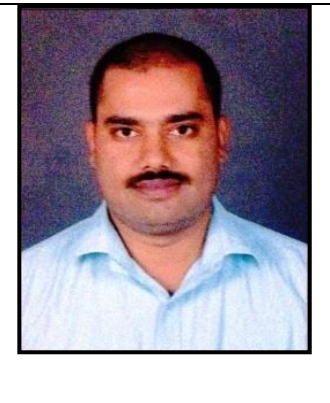
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**BIOGRAPHIES**

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