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Durability Study of Mortar in Chemical Attack with Different Percentages of Superplasticizer

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Abstract: ***Durability is defined as its ability to resist weathering action, chemical attack, abrasion, or any other process of deterioration. Durable concrete will retain its original form, quality, and serviceability when exposed to environment. We have studied varying four different percentage of superplasticizer, study of effect of superplasticizer on various properties such as effect on consistency and initial setting time of ordinary Portland cement 43 grade, effect of superplasticizer on strength development of various types of mortar in normal environment, effect of superplasticizer on strength development of various types of mortar in acidic environment.In this investigation significant attention have been given to use superplasticizer as a chemical admixture on mortar.***

Keywords: Superplasticizer, Compressive strength

1. Introduction

Superplasticizers, also known as high range water reducers, are chemical admixtures used where well-dispersed particle suspension is required. These polymers unit used as dispersants to avoid particle segregation (gravel, coarse and fine sands), and to spice up the flow characteristics (rheology) of suspensions like in concrete applications. Their addition to concrete or mortar permits the reduction of the water to cement magnitude relation, not poignant the workability of the mixture, and permits the assembly of self-consolidating concrete and high performance concrete. This impact drastically improves the performance of the hardening contemporary paste. The strength of concrete will increase once the water to cement quantitative relation decreases.Admixtures intercalary in transit through machine-driven slump management systems, permits a concrete producer to take care of slump till discharge while not reducing concrete quality.

2. Literature Review

Dumne M.S. (2014) in this research researchers had underscored the use of mineral and chemical admixtures imparts the desirable properties to concrete in both fresh and hardened state. This paper includes the influence of superplasticizer dose of 0.25, 0.30 and 0.35percentage on performance of Self-Compacting Concrete containing 10% fly ash of cement content. The experimental tests for fresh and hardened properties of Self-Compacting Concrete for three mixes of M20 grade were studied and the results were compared with normal vibrated concrete. The tests considered for study were, slump test, compaction factor test, unit weight and compressive strength test the results show that for the constant watercement ratio, increase of superplasticizer dose in Self-Compacting Concrete leads to gain of good self compaction ability in addition to marginal reduction in unit weight. There was also slightly increase in compressive strength than that of normal concrete mix.

Alsadey Salahaldein (2015) in this investigation, significant attention had been given to use superplasticizer as a chemical admixture on concrete. However, the use of chemical admixtures in concrete is a common solution to achieve highperformance concrete. This paper had been made an attempt to study the influence of superplasticizer dose of 0.6, 0.8, 1.2, 1.8 and 2.5 percentages on performance of concrete. The experimental tests for fresh and hardened properties of concrete for M35 grade were studied and the results were compared with normal concrete. The tests considered for study were, slump test and compressive strength test The results show that the increase of superplasticizer dose in concrete leads to gain of good ability in addition to slump. Moreover, there was also slightly increase in compressive strength than that of normal concrete.

Singh A. (2017) in the present study the evaluation of initial setting time due to superplasticizers had been investigated. Three superplasticizers were used in this study with different properties and aiming to determine the delay in initial setting time due to superplasticizer. Initial setting time was calculated as per IS: 4031-PART 5-1988 with different SP dosages (0.5%, 0.75%, 1.0% and 1.5% of weight of cement). Superplasticizer was an admixture which reduces the water-cement ratio or increases the workability at the same water content.

3. Methodology& Materials

The cement taken was Ordinary Portland Cement (OPC) of 43 grade of uniform consistencyConforming to IS 8112-1989. The test for specific gravity, standard consistency, initial and final setting time and 28 day compressive strength have been conducted.

3.1 Aggregate

The fine aggregate used throughout the research was quartzite in origin and there source of location was bazpur quarry pit in bazpur Uttrakhand. Aggregate constitute grately influence the behaviour of mortar since they occupy about 80%of the total volume of mortar.

3.2. Fine Aggregates

Aggregate occupy a large volume in concrete mixture and give dimensional stability to mortar. In ferrocement only fine aggregate (sand) is used particle size less than 4.75mm. Sand consists of little angular or rounded grains of silicon oxide and is usually used because the fine mixture in cement mortar it fills the present voids and reduces shrinkage and cracking of mortar. It helps in hardening of cement by

permitting the water through its voids. To form arduous mass of silicates, as it is believed that, some chemical reaction takes place between silica of sand and constituents ofcement. The fine aggregates assist the cement paste to prevent the possible segregation.

Table 3.1: Sieve Analysis Data of Fine Aggregate

S.No.	IS-Sieve (mm)	Wt. Retained (gm)	%age Retained	%age passing	Cumulative % retained
1	4.75	5	0.7	99.3	0.7
2	2.36	60	5.8	94.2	6.5
3	1.18	134	13.6	86.4	20.1
4	600 µ	243	24.10	75.9	44.2
5	300 µ	415	41.7	58.3	85.9
6	150 µ	122	12.0	88	97.9
7	Pan	21	2.1	SUM	255.0
TOTAL			1000	1000	FM=2.55

3.3 Admixtures

Anything added in the mortar other then water , cement and fine aggregate in order to modify its property is termed as an admixture. These are organic substances or a mixture of organic and inorganic substances that allow the reduction of water for the formation of mortar having some workability or same water cement ratio, helps in formation of highly workable mix. The normal dosage varies between 0.1 % to 2.5% that allows the reduction of water cement ratio by 20% to 40% or increase the workability.

3.3.1 Superplasticizer

SP used in this study is based on modified polycarboxylate High early strength: Significant increase of early strength and 28d strength. Low slump lose: Great reduction of slump lose. Excellent durability: Reduction of cracking, shrinkage and creep. High water reduction: Water reduction over twenty fifth in step with completely different application. Environmental friendly products: Non pollution during production.

3.4 Water

Any water pH of 6.0 to 8.0 which does not taste saline or brackish is suitable for use. Colour and odour do not necessarily mean that deleterious substances are present in water. Natural water sidely acidic are harmless. But water content homic or other organic acid may adversely affect the strength of concrete (nebille, properties of concrete, long man scientific and technical publication 1994) tap water portable without any salts or chemicals was used in this study.

4. Calculation

The laboratory experiments were performed in three different parts, these are:

1) Evaluation of initial setting time due to superplasticizer.
2) Effect on compressive strength on cement mortar.
3) Effect of acidic aggressive environment on strength of mortar.

Table 4.1: Specific gravity of cement

Sr. No.	Observations	Results
1.	Weight of empty bottle W1 g	57
2.	Weight of bottle + water W2 g	157
3.	Weight of bottle + Kerosene W3 g	136
4.	Weight of bottle + Cement + Full Kerosene W4 g	174
5.	Weight of cement W5 g = 50	50
6.	Specific gravity of Kerosene Sk = [W3 - W1 /W2 - W1]	0.79 g/cc
7.	Sp. gravity of cement = W5*(W3 - W1)/ (W5+W3-W4)*(W2-W1)	3.29 g/cc

Table 4.2: Soundness of cement

Initial distance b/w indicator end D_1	25mm
Final distance b/w indicator D_2	19mm
Cement expansions (D_2- D_1)	6mm
Permissible limit (IS 269-1976)	Should not be more then 10mm

4.1 Evaluation of initial setting time due to superplasticizer.

The effect of superplasticizer on setting of cement pastes when mixed in different dosages and to compare the performances of polycarboxylatesuperplasticizers. In present investigations, polycarboxylatesuperplasticizer dosages (0.5%. 1.0%, 1.5%, 2% of weight of cement) are provided in cement and cement paste is prepared with the desired consistency. Abbreviations of some cement mix designations. Initial setting time has been seen as per is: 4031part 5-1988 respectively. Penetration readings were taken after every 5 minutes to assess change in rheological properties.

Table 4.3: Penetration at every 5 minutes SP (PCE)

Time (minutes)	SP Dosage (%)			
	0.5%	1.0%	1.5%	2.0%
0	0	0	0	0
5	0	0	0	0
10	0	0	0	0
15	0	0	0	0
20	0.5	0	0	0
25	1.0	0.5	0	0
30	1.5	0.5	0	0
35	2.0	1.0	0	0
40	2.5	1.0	0	0
45	3.0	1.5	0.5	0
50	3.5	2.0	0.5	0.5
55	4.0	2.5	1.0	0.5
60	4.5	3.0	1.5	1.0
65	5.0	3.5	2.0	1.5
70	5.5	4.0	2.5	2.0
75	6.0	4.5	3.0	2.5
80		5.0	3.5	3.0
85		5.5	4.0	3.5
90			4.5	4.0
95			5.0	4.5
100			5.5	5.0
105			6.0	5.5
110				6.0
115				
IST (minute)	75	85	105	110

5. Result

Table 5.1: Compressive strength of all mortar mixes

Portable Water Curing								
SP Dosages	1:4 Ratio				1:6 Ratio			
	7days		28 days		7days		28 days	
	Load	CS (N/mm^2)	Load	CS (N/mm^2)	Load	CS (N/mm^2)	Load	CS (N/mm^2)
CM	97.61	19.63	145.40	29.25	96.81	19.47	118.77	23.89
0.5	108.0	21.73	147.60	29.70	99.68	20.05	120.69	24.28
1.0	117.0	23.54	154.66	31.10	106.14	21.36	139.16	28
1.5	116.08	23.35	146.36	29.44	97.81	19.67	112.48	22.63
2.0	89.60	18.03	140.14	28.20	85.22	17.15	103.61	20.85

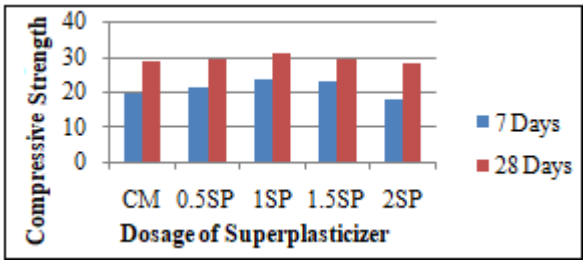

Figure 5.1: (Graphical representation of mortar cubes under water curing with SP dosages after 7 days and 28 days) [1:4]

Table 5.2: Compressive strength after 7 days and 28 days of $1NH_2SO_4$

$1NH_2SO_4$						
SP Dosages	1:4 Ratio				Decrement in compressive strength	
	7days		28 days		7days	28 days
	Load	CS (N/mm^2)	Load	CS (N/mm^2)		
0.5	102.77	20.67	142.98	28.76	10.5	8.46
1.0	110.12	22.15	152.62	30.70	5.42	10.13
1.5	105.96	21.32	132.26	26.61	5.18	8.13
2.0	84.72	17.04	128.36	25.83	5.46	13.85

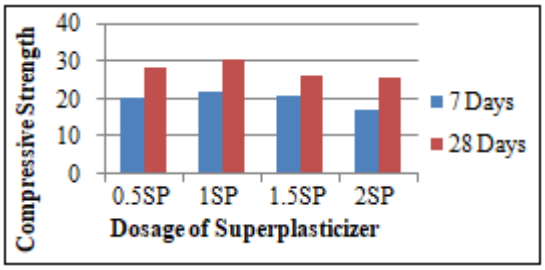

Figure 5.3: (Compressive Strength of $1NH_2SO_4$with SP Dosage 7 Days & 28 Days [1:4]

Table 5.3: Compressive strength after 7 days and 28 days of $1NH_2SO_4$

$1NH_2SO_4$						
SP Dosages	1:6 Ratio				Decrement in compressive strength	
	7days		28 days		7days	28 days
	Load	CS (N/mm^2)	Load	CS (N/mm^2)		
0.5	86.62	17.43	111.12	22.36	2.49	5.78
1.0	99.02	19.92	134.98	27.16	10.98	9.45
1.5	81.16	16.33	104.12	20.95	2.66	17.18
2.0	69.62	14	89.44	17.99	1.05	15.07

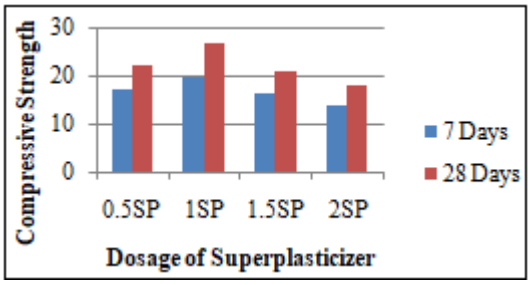

Figure 5.4: (Compressive Strength of $1NH_2SO_4$ with SP Dosage 7 Days & 28 Days) [1:6]

6. Discussion of Results

A superplasticizer reduces the required water cement ratio but at the same time delays the setting time of cement paste. The use of superplasticizer delays setting evaluation of initial setting time Compressive strength of concrete increases with the use of super plasticizers. Inclusion of superplasticizer and retarder in concrete enable concrete to have a better cohesiveness without segregation. Polycarboxylic ether based super plasticizer produces better dispersion, flow characteristics and water retention compared to various superplasticizers.

7. Conclusion

Cement mortar are vital components in building construction today. Cement mortar is strong in compression but weak in tension. Properties of mortar containing superplasticizer had been successfully studied. Cement mortar specimens is immersed in the sulphuric acid solution. Over the periods, changes to the roughened surfaces, mass change and neutralization depth is observed. Corrosion of cement mortar progressed through chemical reaction of sulphuric acid and ion transport in mortar. Relations between the environment operation of sulphuric acid and the corrosion (summation of chemical erosion and neutralization depth) of test specimens are presented.

From the results of the study presented earlier, the following conclusions are the conclusions which are coming from the results obtained in the experimental study.

Effect on compressive strength of cement mortars in acidic environment

Compressive strength increase when dosage exceed to 1.0% & 1.5% but there is decrease in compressive strength when dosage exceed to 2.0%.

Mortar Specimen (1:4 Ratio)

- Compressive strength after 28 days water curing are 29.70, 31.10, 29.44 and 28.20 with superplasticizer dosages 0.5, 1.0% 1.5% and 2% respectively.
- The decrement of the strength after 28 days for $1NH_2SO_4$ are 8.46%,10.13%,8.13%,13.85% as compare to the cubes specimen curing in potable water.
- Compressive strength is improved by superplasticizer. On the other hand, its ultimate strength is higher than the desired characteristic strength.
- The effect of the sulphuric acid environment on concrete is to decrease its compressive strength and this loss increases as a function of sulphate ion concentration and age of exposure.

Mortar Specimen (1:6 Ratio)

- Compressive strength after 28 days water curing are 23.89, 24.28, 28, 22.63 and 20.85 with superplasticizer dosages 0.5, 1.0% 1.5% and 2% respectively.
- The decrement of the strength after 28 days for $1NH_2SO_4$ are 5.78%,9.45%,17.18% and 15.07% as compare to the cubes specimen curing in potable water.
- However, very high dosages of superplasticizer tend to impair the cohesiveness of mortar.
- Compressive strength is improved by superplasticizer. On the other hand, its ultimate strength is higher than the desired characteristic strength.
- The effect of the sulphuric acid environment on concrete is to decrease its compressive strength and this loss increases as a function of sulphate ion concentration and age of exposure.

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