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The Effect of Admixtures on Concrete Properties

Shaikhdar Mufiturrahemanwahed Nawabsab
Prof. Hamane A. A.
Department of Structural Engineering, M.S. Bidve Engineering College, Latur, India

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ABSTRACT:
In this study super plasticizers admixtures were used for the three grades ofconcrete 15 toimprove the properties of fresh and hardenconcrete in hot weather to achieve these properties in the summerseason of Latur:

- Increase the workability
- Increase the compressive strength by adoption super plasticizers admixtures which increase the workability and hence the strength is increased through the reduction of water content.
- Reduce the cement content and hence cost saving.

Keywords: Introduction,Concrete & Admixtures, Experimental Work, Test Results and Discussion,Conclusions and Recommendations.

I. INTRODUCTION

Concrete, in the broadest sense, is any product or mass made by the use of cementing medium. Generally, this medium is the product of reaction between hydraulic cement and water. Concrete is made with several types of cement and also containing pozzolana, fly ash, blast furnace slag, etc., The main components of concrete are a mixture of cement, water, aggregate (fine and coarse) and sometimes admixtures.

The objective of this research is to study the effect of using concrete admixtures to improve concrete properties both in its fresh and hardened stages in the extremely hot and dry weather.

This can be achieved through experimental work on:

1. Improvement of workability.
2. Increasing of strength.
3. Reducing cement content, hence cost saving.

1.1.1 Properties of fresh concrete

Fresh concrete is a mixture of water, cement, aggregate and admixture. After mixing, operation such as transporting, placing , compacting and finishing of fresh concrete can all considerably affect the properties of harden concrete. It is important that the constituents materials remain uniformly distributed within the concrete mass during the various stages of its handling and that full compaction is achieved.

The characteristics of fresh concrete which affect full compaction are its:

- Consistency.
- Mobility.
- Compactability.

Factors affecting workability

- Cement and water
- Admixtures
- Aggregate type and grading
- Ambient conditions (temperature, humidity, wind velocity)
- Time

1.1.2 Properties of hardened concrete

The properties of fresh concrete are important only in the first few hours of its history whereas the properties of harden concrete assume an important which is retained the remainder of the life of concrete.Components selection.

The important properties of hardened concrete are:

- Strength
- Deformation under load
- Durability
- Permeability
- Shrinkage

Factors influencing strength

Several factors which affect the strength of concrete are listed below:

- Influence of the constituent materials (cement, water, aggregate, admixtures).
- Influence of the methods of preparation.
- Influence of curing
- Influence of test conditions.

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1.1.3 Concrete Admixtures

Admixtures are substances introduced into concrete mixes in order to alter or improve the properties of the fresh or hardened concrete or both.

In general, these changes are effected through the influence of the admixture on hydration, liberation of heat, formation of pores and the development of the gel structure.

Concrete admixtures should only be considered for use when the required modification cannot be made by varying the composition and proportions of the basic constituents' materials, or when the admixtures can produce the required effect more economically.

The specific effects of an admixture generally vary with.

- Type of cement
- Cement-water ratio
- Ambient conditions (particularly temperature)
- Its dosage.

Superplasticizers.

Superplasticizers are admixtures which are water reducing but significantly and distinctly more so than water reducing admixtures.

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There exist four main categories of superplasticizers:

- Sulfonated melamine-formaldehyde condensates
- Sulfonated naphthalene- formaldehyde condensates
- Modified lignosulfonates
- Others such as sulfonic- acids esters and carbohydrate esters.

The first two are the most common ones, for brevity, they will be referring to as:

- melamine – based superplasticizers
- naphthalene-based superplasticizers

The main action of the long molecules is to wrap themselves around the cement particles and give them a high negative charge so that they repel each other.

These results in deflocculating and dispersion of cement particles.

The resulting improvement in workability can be exploited in two ways:

- by producing concrete with a very high workability
- or concrete with a very high strength

1.2 EXPERMENTAL WORK

1.2.1 Concrete Mix Design

Concrete mix design can be defined as the procedure by which, for any given set of conditions, the proportion of the constituent materials are chosen so as to produce a concrete with all the required properties for the minimum cost. The cost of the mix design includes.

- The materials
- The cost of the mix design, of batching, mixing and placing the concrete and of side supervision

1.2.2 Mix proportions

For the three grades (15) N/mm2 we used:
Cement type: ordinary Portland cement.
Coarse aggregate type: crushed.
Fine aggregate type: uncrushed.
Maximum aggregate size: 20 mm.
Workability: medium (30 – 60) mm.
Concrete density: 2400kg/m3

Mix (M_{15})

Characteristic compressive strength = 15 N/mm2 at 28 days.
Target mean compressive strength = 28 N/mm2
Water/ cement ratio = 0.70.
Total aggregate content = 1890kg/ m3
Quantities per m3

Cement (kg)	Water(kg)	Fine aggregate(kg)	Coarse aggregate (kg)
300	210	700	1190

1.2.3 Experimental Work

Where the main requirement is to:

- Improve workability
- Increase strength.
- reduce cement content, hence cost saving

Beside the ordinary reference mixes, chemical admixtures should be used. These admixtures are:
High performance super plasticising admixture (conplast sp432ms)
The study will be divided to theses phases:

A. Materials test

- Test of base materials, i.e. cement , aggregate , water and admixture
- the effect of recommended doses of admixture on the properties of fresh and hardened concrete , i.e. (workability & strengths)

B. **Testing program**

Grade 15

1. Ordinary reference mix (RM).

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(12 cubes+3cylinder+3beams)
- 3 cubes will be crushed on 7 days
- 3 cubes will be crushed on 14 days
- 3 cubes will be crushed on 28 days
- 3 cubes will be crushed on 90 days

2. Reference mix admixture to increase workability (WrM).
(12 cubes)
3. Mix with admixture and same workability to increase strength (StM).
(12 cubes)
4. Mix with admixture to reduce cement content keeping same strength and workability (CrM).
(12 cubes)

Notice
- All specimens will be cured on the laboratory room temperature up to the date of test.
- Ordinary Portland cement will be used.
- Medium workability (30___60).

II. RESULT AND DISCUSSION

The results obtained are as discussed below

2.1.1 Test Results of The Specimens

Table(2.1): Results of compressive cube strength grade 15

(RM) Reference mix (without admixture)
slump = 55mm w/c = 0.7
(Cube dimension 150*150*150mm)

Dateofcast	Dateoftest	Age(days)	Weight (Kg)	Load (KN)	Strength (N/mm^2)	Meanstrength (N/mm^2)
22/05/2021	29/05/2021	7	8.50	610	27.11	26.52
22/05/2021	29/05/2021	7	9.07	600	26.66	
22/05/2021	29/05/2021	7	8.70	580	25.78	
22/05/2021	05/06/2021	14	8.42	700	31.11	31.33
22/05/2021	05/06/2021	14	8.62	700	31.11	
22/05/2021	05/06/2021	14	8.49	715	31.77	
22/05/2021	19/06/2021	28	9.02	810	36.00	34.89
22/05/2021	19/06/2021	28	8.47	765	34.00	
22/05/2021	19/06/2021	28	8.44	780	34.67	
22/05/2021	20/08/2021	90	8.60	870	38.67	37.63
22/05/2021	20/08/2021	90	8.57	900	40.00	
22/05/2021	20/08/2021	90	8.59	770	34.22	

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Table(2.2): Results of compressive cube strength grade 15
(WrM) (mix +1LIT/100kg cementious material)
slump = 160mm W/C = 0.7
to improve workability
(Cube dimension 150*150*150mm)

Dateofcast	Dateoftest	Age (Days)	Weight (Kg)	Load (KN)	Strength (N/mm^2)	Meanstrength (N/mm^2)
05/06/2021	12/06/2021	7	9.11	760	33.78	34.00
05/06/2021	12/06/2021	7	9.01	745	33.11	
05/06/2021	12/06/2021	7	9.11	790	35.11	
05/06/2021	19/06/2021	14	8.51	740	32.89	34.00
05/06/2021	19/06/2021	14	8.26	800	35.56	
05/06/2021	19/06/2021	14	8.76	755	33.56	
05/06/2021	03/07/2021	28	8.75	950	42.22	42.22
05/06/2021	03/07/2021	28	9.18	960	42.67	
05/06/2021	03/07/2021	28	8.69	940	41.78	
05/06/2021	03/09/2021	90	8.80	1120	49.78	50.30
05/06/2021	03/09/2021	90	8.77	1140	50.67	
05/06/2021	03/09/2021	90	8.89	1135	50.44	

Table(2.3): Results of compressive cube strength grade15
(StM) (mix +1.5lt/100kg cementious material)
decrease the water content from 210 to 160 kg/lt
slump = 60mm w/c=.0.53
to increase strength
(Cube dimension 150*150*150mm)

Dateofcast	Dateoftest	Age (days)	weight (Kg)	Load (KN)	Strength (N/mm^2)	Meanstrength (N/mm^2)
6/19/2021	6/26/2021	7	8.82	750	33.33	33.19
6/19/2021	6/26/2021	7	8.67	720	32.00	
6/19/2021	6/26/2021	7	8.76	770	34.22	

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6/19/2021	7/3/2021	14	8.32	1025	45.56	43.26
6/19/2021	7/3/2021	14	8.77	895	39.77	
6/19/2021	7/3/2021	14	8.75	1000	44.44	
6/19/2021	7/17/2021	28	8.575	1000	44.44	45.11
6/19/2021	7/17/2021	28	8.63	1090	48.44	
6/19/2021	7/17/2021	28	8.46	955	42.44	
6/19/2021	9/17/2021	90	8.64	1185	52.67	50.96
6/19/2021	9/17/2021	90	8.40	1090	48.44	
6/19/2021	9/17/2021	90	8.78	1165	51.78	

Table(2.4): Results of compressive cube strength grade15
(CrM) (mix +1.5lt/100kg cementious material)
decrease the water content from 210 to 160 kg/lt
slump = 50mm w/c=.0.70
To reduce the cement content from 300kg to 228.57kg (Cr ratio=23.3%)
(Cube dimension 150*150*150mm)

Dateofcast	Dateoftest	Age (Days)	Weight (Kg)	Load (KN)	Strength (N/mm^2)	Meanstrength (N/mm^2)
7/24/2021	7/31/2021	7	8.64	480	21.33	21.63
7/24/2021	7/31/2021	7	8.70	480	21.33	
7/24/2021	7/31/2021	7	8.51	500	22.22	
7/24/2021	8/7/2021	14	8.42	660	29.33	27.93
7/24/2021	8/7/2021	14	8.62	6350	28.22	
7/24/2021	8/7/2021	14	8.65	590	26.22	
7/24/2021	8/21/2021	28	8.80	645	28.67	31.70
7/24/2021	8/21/2021	28	8.54	785	34.89	
7/24/2021	8/21/2021	28	8.81	710	31.56	

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7/24/2021	10/22/2021	90	8.77	870	38.67	38.07
7/24/2021	10/22/2021	90	8.80	850	37.78	
7/24/2021	10/22/2021	90	8.60	850	37.78	

Table(2.5) Results of cubes compressive strength Grade 15

Mixspecification	**Slump(mm)**	**Age (days)**	**Meanstrength (N/mm^2)**
(RM) Referencemix	55	7	26.52
		14	31.33
		28	34.89
		90	37.63
(WrM) samemixwithadmixture to increase workability	160	7	28.19
		14	36.00
		28	42.22
		90	50.30
(StM) Mixwithadmixtureand same workability to increasestrength	60	7	34.00
		14	41.26
		28	45.11
		90	50.96
(CrM) Mixwithadmixturetoreduce cement content keeping samestrength&workability	50	7	21.63
		14	27.92
		28	31.70

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		90	38.07

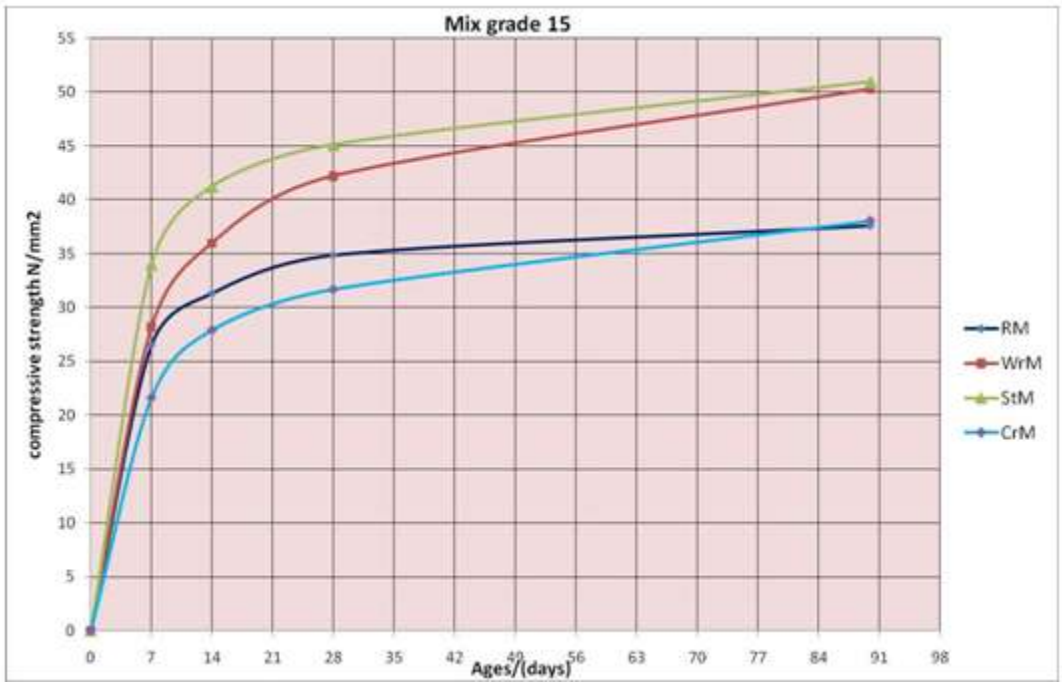

Figure (2.1) compressive strength development for different mixes grade15

III. CONCLUSION

The results from the various testes for the grade (15) conducted on the fresh and hardened state of concrete mixes lead to the following observations:

- Super plasticizers admixtures improve the workability without increasing water demand, for the three grades of concrete no decreasing in compressive strength was observed.
- Super plasticizers admixtures provide an increasing in ultimate strength gain by significantly reducing water demand in a concrete mix for the three grades, without affecting workability.
- Super plasticizers admixtures reduce cement content up to 23%for the three grades without reducing the compressive strength and no effect on workability.
- Super plasticizers admixtures provide improved durability by increasing ultimate strength and reducing w/c ratio.
- Super plasticizers admixtures save cost of the reduced cement of about (4.5 – 8.9)% per cubic meter for the grade of concrete.

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