Influence of Superplasticizer and Sugar Admixture on Strength Characteristics of Concrete Structure

Prabhat Mishra[1], K Divya Kotecha[2]

[12]*Department of Civil Engineering, RSR Rungta College of Engineering and Technology, Bhilai*

ABSTRACT

Concrete is an inevitable material in the human being's life, because of its superior characteristics like strength and durability, but in certain situations it can't be used in all places because setting time of concrete. Concrete derives its strength by the hydration of cement particles. The hydration of cement is not a momentary action but a process continuing for long time. Of course, the rate of hydration is fast to start with, but continues over a very long time at a decreasing rate. Curing is being given a place of increasing importance as the demand for high quality concrete is increasing. It has been recognized that the quality of concrete shows all round improvement with efficient uninterrupted curing. Water curing satisfies all requirements of curing but longer time process and water consumption is more. Hot water cured concrete does not exhibit retrogression of strength. The purpose of this investigation is to conduct a compressive test program on different curing conditions affect the attainable strength of concrete.

Keywords: Concrete, Super Plasticizer, Compressive strength.

I. INTRODUCTION

Concrete is a composite material in which a binding material mixed in water on solidification binds the inert particles of well graded fine and coarse aggregates. Cement and lime are generally used as binding materials, whereas sand cinder is used as fine aggregates and crushed stones, gravel, broken bricks, clinkers are used as coarse aggregates. The superplasticizers (SP) are referred to as high range water reducing admixture by ASTMC494, which mainly disperses the water in concrete matrix. This property is some time called as dispersion-fluidification property of concrete admixture. Also, Sugar is used as admixture in the concrete production. White crystalline solid readily soluble in water and available in market has been used in this experimentation work.

II. METHODOLOGY

The concrete mix has been done as per IS 10262 – 1982, IS 456-2000. Target mean strength for M40 grade concrete is 62.44 N/mm2. The quantities of concreate mix proportion for one cubic meter of concrete and one cement bag. Standard mould of size 15×15×15 cm is used in the preparation of cubes. The super plasticizer, sugar and mixture of both are mixed with the constituents of concrete at the time of adding water with 0%, 0.05% and 0.1% respectively. To ensure by mixing of the admixture and the concrete is at least two minutes of periods. The mould has been cleaned to remove dust particles and applied with oil on all sides before the concrete is poured into the mould.

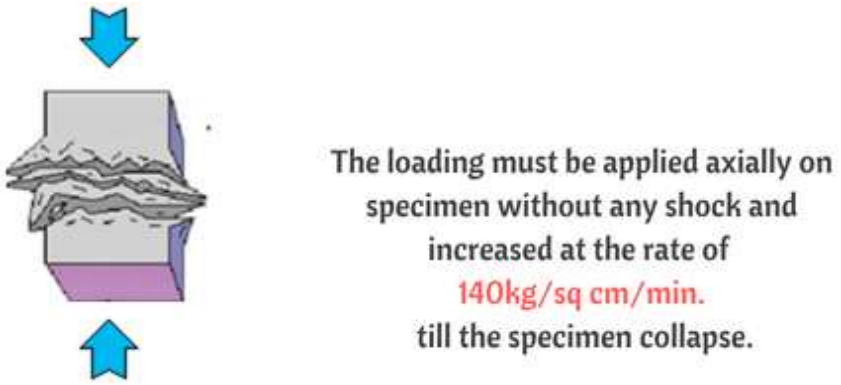


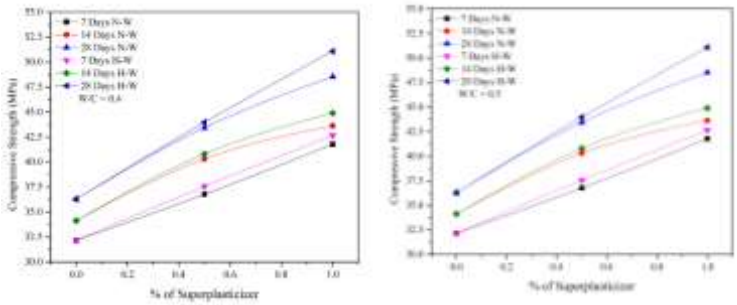
Fig 1. Concrete cracking due to compression force

Table 1. Mix design for M40 grade concrete for varying admixture and its percentage

Mix Number	Admixture	% of admixture	W/C ratio	Cement (kg/m^3)	Fine Agg. (kg/m^3)	Coarse Agg. (kg/m^3)
1	---	0.0	0.40	400	623	1085
2	Superplasticizer	0.5	0.40	400	623	1085
3	Superplasticizer	1.0	0.40	400	623	1085
4	Sugar	0.5	0.40	400	623	1085
5	Sugar	1.0	0.40	400	623	1085
6	SP+S	0.5	0.40	400	623	1085
7	SP+S	1.0	0.40	400	623	1085
8	---	0.0	0.50	360	650	1132
9	Superplasticizer	0.5	0.50	360	650	1132
10	Superplasticizer	1.0	0.50	360	650	1132
11	Sugar	0.5	0.50	360	650	1132
12	Sugar	1.0	0.50	360	650	1132
13	SP+S	0.5	0.50	360	650	1132
14	SP+S	1.0	0.50	360	650	1132

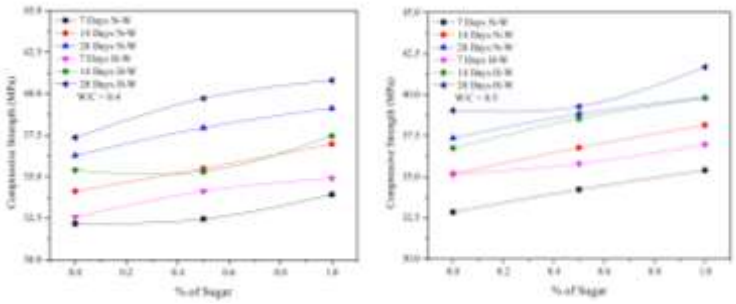
III. RESULT AND DISCUSSIONS

A series of experimental test have been performed by adding different percentage of percentage admixture in concrete. Firstly, slump tests have been conducted using slump cone test for considered samples of concrete without and with superplasticizer and sugar admixtures with different aspect percentages (0%, 0.25% and 0.5%) for water cement ratio 0.40 and 0.50.



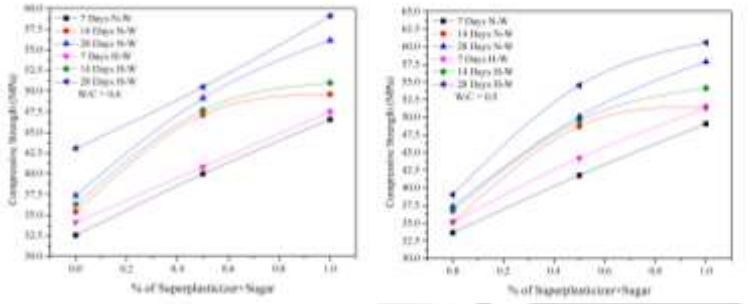
(a) (b)

Fig 2. Variation of compressive strength of concrete with different percentage of SP under normal and hot water (a) w/c = 0.4 (b) w/c = 0.5



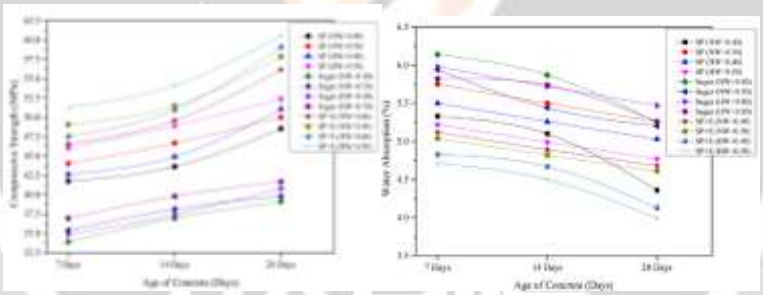
(b) (b)

Fig 3. Variation of compressive strength of concrete with different percentage of sugar under normal and hot water (a) w/c = 0.4 (b) w/c = 0.5



(c) (b)

Fig 4. Variation of compressive strength of concrete with different percentage of SP+S under normal and hot water (a) w/c = 0.4 (b) w/c = 0.5



(d) (b)

Fig 5. Variation of (a) compressive strength and (b) water absorption (%) of concrete with age of concrete at admixture dosage = 1%

Optimum dosage of SP+S has been found based on the lowest water absorption that they present at the age of 28 days. From the Figure 5 (a) and (b), it can observe that optimum dosage for admixtures is superplasticizer + sugar (SP+S). Dosage with lower or higher than this optimum value will increase the water absorption.

IV. CONCLUSION

- From the results of the work, the workability of concrete has been increased by addition of admixture viz. superplasticizer, sugar and mixture of both admixture (Superplasticizer + Sugar). However, very high dosages of admixture tend to impair cohesiveness of concrete.
- Compressive strength is improved by admixtures for all ages compared with control.
- With the addition of superplasticizer (SP), sugar (S) and superplasticizer + sugar (SP+S) 0 to 1% compressive strength increases with the increase of dosages of admixtures, but a certain limit of dosage of admixture has been reduce the compressive strength of concrete. The maximum strength has been seen in 1% of admixture.
- Work has been carried out on for 7, 14 and 28 days of curing in normal and hot water conditions and it was found that hot water curing produced more compressive strength in the investigated systems.
- After the test results, it is indicated that the strength of the curing done in hot water is more than that of curing in normal water because hot water curing hydrate the concrete faster than usually desirable.

- It has been found that, if both admixtures (SP+S) were added to the concrete, the compressive strength of concrete is higher than the others. Superplasticizer enhance in workability at a given water-cement ratio. Sugar is actually a well-known "retardant" of concrete and is often used to help adjust the setting times. The setting process is slowed down because it interferes with the chemical reaction that causes cement to set when water is added. Therefore, the addition of both mixtures increases the strength of concrete.
- Use of super plasticizers allow the reduction of water to the extent up to 30%. It can be used at the higher dosage in the range of 0.5 – 3% by weight of cement as per literature.
- Water absorption reduces when dosage of admixture increases. Optimum dosage of SP+S has been found based on the lowest water absorption that they present at the age of 28 days. It can observe that optimum dosage for admixtures is superplasticizer+sugar (SP+S). Dosage with lower or higher than this optimum value will increase the water absorption.

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