



## LABORATORY STUDIES FOR DETERMINING EFFECT OF SUGAR ON SETTING TIME OF CEMENT AND PROPERTIES OF CONCRETE

(Received: 20 November 2015; Revised: 03 December 2015; Accepted: 20 January 2016)  
(Article Type: Research, Theme: Concrete Technology)

Dr. N. Balasubramanya  
Professor & Guide  
Department of Civil Engineering  
Acharya Institute of Technology  
Bangalore, India  
E-mail: [balasubramanyan@acharya.ac.in](mailto:balasubramanyan@acharya.ac.in)

Adarsh A., Vinay, Vidyadhar Patil & Sunil Kumar  
Scholars  
Department of Civil Engineering  
Acharya Institute of Technology  
Bangalore, India

**Abstract** - Cement and Concrete are the most important engineering materials in the construction industry. Atmospheric conditions play crucial roles on the properties of concrete. Hence admixtures are used to maintain standard conditions. Experimental investigations on the effect of sugar on setting time of Birla 53 Grade Cement and properties of concrete made out of it were carried out for different percentages of Sugar (0.00, 0.03, 0.05, 0.06, 0.08, 0.15 and 0.2%) by weight of cement and water cement ratios 0.5 & 0.35. Initial setting time of concrete retarded upto 0.08% sugar content. Slump varied from Shear to Collapse with increase in Sugar content at 0.5 w/c ratio, and it changed from shear to true for 0.35 w/c ratio. Compressive strength showed increasing values with increase in sugar contents for all the specimens, In particular a 40% increase in the compressive strength when the sugar content was 0.06% and the concrete made of 0.35 w/c ratio. Similarly, Split tensile strength of cylinders also increasing trend with increase in sugar content.

**Keywords** – Concrete; cement; compressive; shear; sugar.

### I. INTRODUCTION

Cement and Concrete are the most important engineering materials in the construction industry. Atmospheric conditions play crucial role on the properties of both cement and concrete, and hence admixtures are used.

According to research, sugar is found to be a good admixture. Bazid Khan (2004) reported that initial setting time of cement paste retarded upto a sugar dosage of 0.25% by weight of cement and then accelerated [1]. G.L Oyekan (2007) found that compressive strength of concrete increased nearly 17% at 28 days when the sugar content was 0.1%; however when the sugar content was 0.2% the increase was only 9% [2].

Akogu Elijah Abalaka (2011) worked with 0.05% Sugar in concrete, cured for 3,7,14 and 28 days and reported marginal strength gains in all the cases [3]. Giridhar V. (2013) varied the sugar content from 0 to 0.1% and reported that the compressive strength of concrete increased. After 28 days curing, percentage variation between ordinary concrete and concrete with 0.1% of sugar added was found to be 12% [4].

### II. SCOPE OF THE STUDY

The objective of the present study was to investigate the effect of percentage of Sugar by Weight of cement on the initial setting time of cement, workability, compressive strength and split tensile strength of concrete with two water cement ratios 0.5 and 0.35 and four curing periods 7, 14, 21 & 28 days.

### III. EXPERIMENTAL METHODOLOGY

A series of laboratory tests were carried out on mortar and concrete by adding different percentages of sugar. The tests included determination of Fineness of cement, specific gravity of fine aggregate and coarse aggregates, bulk density of coarse aggregates, crushing strength of coarse aggregate, initial setting time of cement, slump cone test, compressive strength for cubes, and split tensile strength of concrete. Mix proportions chosen for the concrete mix of M40 grade were as per IS 10262-2009, and Slump test, compressive strength and split tensile strength were carried out with w/c ratio 0.5 and 0.35 [5]. All these were carried out as per the respective IS Standards using standard instrumentation.

*For the undying research spirit within you....*



The materials made use of in this research includes Cement (53 grade Birla super cement having a specific gravity of 3.15), Fine aggregates (Locally available river sand confirming to grading zone 2 of IS383), Coarse aggregate (Crushed stone obtained from local sources confirming to IS 383), Water (Drinking water confirming to IS10500), and Admixture (Sugar crystals commonly available in the market) [6-10].

## IV. RESULTS AND DISCUSSION

The result of the effect of sugar on initial setting time is apparent up to sugar content of 0.08%, thereafter it was observed to reduce. It may be interesting to note that the delay in initial setting time for 0.08% sugar content w/c of 0.5 is 387.5% (4.875 folds) when compared to that with 0% sugar content. The same is illustrated in Figure 1.

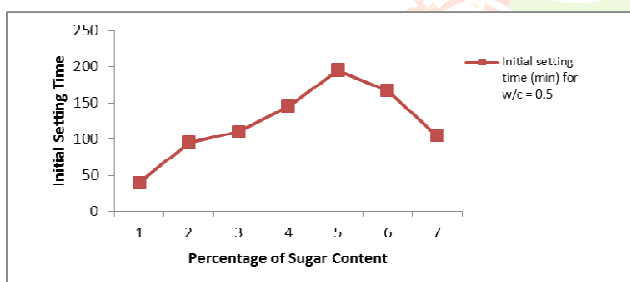


Fig. 1: Variation of initial setting time with % sugar content.

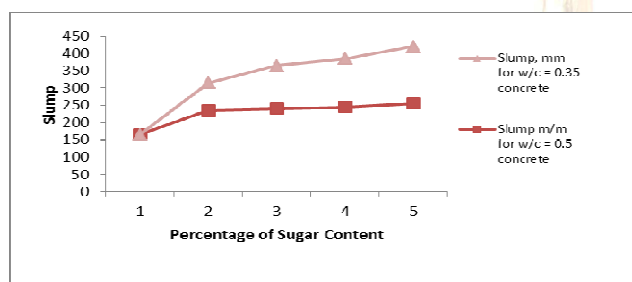


Fig. 2: Variation of slump of M40 concrete with percentage sugar content, w/c of 0.5 and 0.35.

The result of the effect of sugar on slump is illustrated under Figure 2, for the variation of slump of M40 Concrete prepared as per the mix design IS8112 and w/c of 0.5 and 0.35. It can be observed that slump values of concrete made of w/c as 0.5 keeps on increasing with increase in sugar content.

The slump changing from shear to collapse for concrete prepared with w/c as 0.35 was very harsh for 0% sugar content, but kept showing a steady increase in slump values making the concrete more workable with % increase in sugar. The slump varied from time to shear thereby indicates the advantage of Sugar being used as an admixture.

Table 1 presents the variation of compressive strength of concrete cubes prepared with w/c as 0.5 and 0.35 at the end of 7, 14, 21 and 28 days. It is found that the 28 days strength with w/c as 0.5 and 0.35 increased with increase in sugar content upto 0.06% and then started reducing. Notable thing was that M40 concrete made of 0.5 water-cement ratio had a compressive strength of 51.8 N/mm<sup>2</sup> while the strength was 56.03 N/mm<sup>2</sup> for that made using w/c = 0.35, a phenomenal 40% increase.

Table 1: Variation of compressive strength of concrete with % increase in Sugar content.

Sugar %	Compressive strength [N/mm <sup>2</sup> ]							
	7 days		14 days		21 days		28 days	
	w/c =0.5	w/c =0.35	w/c =0.5	w/c =0.35	w/c =0.5	w/c =0.35	w/c =0.5	w/c =0.35
0	27.24	-	32.65	-	33.82	-	41.2	-
0.03	32.32	34.66	35.32	37.04	39.78	42.2	43.02	49.80
0.05	32.91	37.06	35.70	40.20	40.41	45.0	44.70	52.40
0.06	33.21	42.01	44.73	49.75	46.39	53.8	51.80	56.03
0.08	30.97	37.11	33.10	43.30	35.33	47.1	42.35	50.77

Table 2: Variation of split tensile strength of concrete cylinders with increase in Sugar content.

Sugar %	Split Tensile Strength [N/mm <sup>2</sup> ]							
	7 days		14 days		21 days		28 days	
	w/c =0.5	w/c =0.35	w/c =0.5	w/c =0.35	w/c =0.5	w/c =0.35	w/c =0.5	w/c =0.35
0	2.23	-	2.61	-	3.01	-	3.1	-
0.03	2.32	2.56	2.73	2.98	3.15	3.33	3.26	3.69
0.05	2.42	2.58	2.81	3.05	3.18	3.41	3.56	3.77
0.06	2.84	2.95	3.12	3.16	3.4	3.61	3.65	3.94
0.08	2.33	2.76	2.71	2.93	3.1	3.29	3.37	3.64

Table 2 presents the variation of Split Tensile Strength of concrete cylinder prepared with w/c as 0.5 and 0.35 at the end of 7, 14, 21 and 28 days, with varying percentages of sugar. The concrete was found to exhibit a similar trend for split tensile strength, as in the results of compressive strength. The peak value reached when the sugar content was 0.06%. Again larger value was indicated for the lower of the two water-cement ratio 0.35.

For the undying research spirit within you....



# The International Reviewer

Volume 3 | Issue 1 | January - June 2016 | pp. 12-14 | ISSN 2395-1575

Dr. N. Balasubramanya et al., Laboratory Studies for Determining Effect of Sugar on Setting Time of Cement....

## V. CONCLUSION

The following conclusion can be drawn from the research employing very small quantities of sugar as an admixture in concrete. Primarily, there was achievement of retardation in initial setting time upto 0.08% sugar content & acceleration beyond that. There was increase in slump (workability of concrete) up to 0.08% sugar content, and in cube compressive strength and split tensile strength and split tensile strength up to 0.06% sugar content. Also reduction in w/c ratio from 0.5 to 0.35 has proved to be extremely effective in terms of true slump formation, with 40% increase in compressive strength when the Sugar content is 0.06%. It may hence also be observed that increase in compressive strength would invariably result in saving of reinforcement and subsequently the cost of construction.

The future studies could include similar investigations on different grades of cement and various mix proportions of concrete, assessment of long term effects of sugar on properties of cement and concrete, and studies for cost comparison with sugar as an admixture with commercially available admixtures.

## REFERENCES

- [1] **Bazid Khan and Bulent Baradan**; *The effect of sugar on setting time of various types of cements*, **Science Vision**, Vol. 8 (1), **2002**.
- [2] **G.L. Okeyan**; *Effect of admixtures on the compressive strength of sandcrete blocks*, **Proc. 32<sup>nd</sup> Conference on World in concrete & Structures**, Singapore, **2007**.
- [3] **Akogu Elijah Abalaka**; *Effects of sugar on physical properties of ordinary Portland cement paste & concrete*, **ATBU Journal of Environmental technology**, **2011**.
- [4] **Giridhar V.**; *Effects of sugar & jiggery on strength properties of concrete*, **IJES**, Vol.2 (10), **2013**.
- [5] **IS 10262 - 2009**.
- [6] **IS 4031 (part 4) - 1988**
- [7] **IS 5513 - 1972**
- [8] **IS 1190**
- [9] **IS 2386 (part 1) - 1963**
- [10] **IS 456 - 2000**

*For the undying research spirit within you....*

**www.theinternationalreviewer.info**  
© Copyright 2013 All rights reserved  
theinternationalreviewer@gmail.com