

## Experimental study of Effect of Sugar on Properties of Concrete

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### Abstract

*The main Objective of this paper is to experimental study of the effect of Sugar on properties of concrete. The experiments have been carried out for evaluation of properties of concrete by using Sugar as admixtures in the concrete. Based on the study of literature, the main function of usage of Sugar is to increase the initial setting time of concrete .Different percentages of admixtures as Sugar are selected in the evaluation as 0, 0.05, 0.1, 0.15, 0.2 and 0.25% by weight of cement. It was concluded after evaluation workability and compressive strength of concrete enhanced when admixtures like Sugar added into the concrete Mix.*

**Keywords:** Sugar, Admixtures, Compressive strength, Setting time and Workability.

### INTRODUCTION

Concrete is tremendously used man made construction material worldwide and obtain by mixing cement, sand, aggregates and water, and sometime admixtures is required in suitable proportions as per requirement's. The strength, durability and other characteristics of concrete depends up on the mix properties of its ingredients, on the proportion of mix, the method of compaction and other control during placing, compaction and curing. Concrete has its superior properties like binding, strength and durability, but it cannot be used in all places due to different weather conditions in different countries. Variation in weather condition and sessions causes changes in the initial setting time of concrete. Retarder and Accelerator are used to increase and decrease the initial setting time of concrete especially in winter sessions and summer sessions respectively. With the help of different type of admixture used such as Retarder-sugar and gypsum etc. and Accelerator-calcium chloride ( $CaCl_2$ ) etc. By going through studying to various review papers and research papers sugar is good admixture to increasing the initial setting

time. Sugar is a carbohydrate, a composition of carbon, oxygen and hydrogen. It can be useful when concreting used in hot weather conditions, when the normal setting time of concrete is shortened by the higher surrounding temperature such as Gujarat, Rajasthan states etc. Very small dosage of the order of 0.05 to 0.1 per cent of the mass of the concrete is enough. 0.05 per cent of sugar can delay initial setting time by about 3 hours. Usually three different percentage of sugar admixtures were taken as by weight of cement.

### LITERATURE REVIEW

Akogu Elijah Abalaka (2011)- According to his studies at a concentration of 0.05% of sugar content by weight of cement. The compressive strength of concrete increased by 11.84% at 3days testing. And for 0.06% obtained maximum compressive strength after 28days of testing.

Bazid Khan and BBulent Baradan- According to their research they found that the setting of cement extended due to the incorporation of sugar by weight of cement upto certain extent of 0.15%,

exceeding this limit of incorporation, it has been acted as accelerator upto 0.3% and the optimum dosage of sugar added to concrete was 0.15%.

Bazid Khan and Ulla Muhammad- In this study they added variable percentage of sugar in different types of cement and came to conclusion that in same types of cement the sugar act as retarder and in some cases it act as accelerator[1-4].

G. L. Oyekan- He studied on the concrete blocks casted with varying percentage of sugar. He added 0.1% and found that the compressive strength of of block was nearly 17% at 28 days. At 0.2% of admixture the 28days strength of block was increased by only 9% but the 14days strength was increased by 56.6%.

### OBJECTIVE

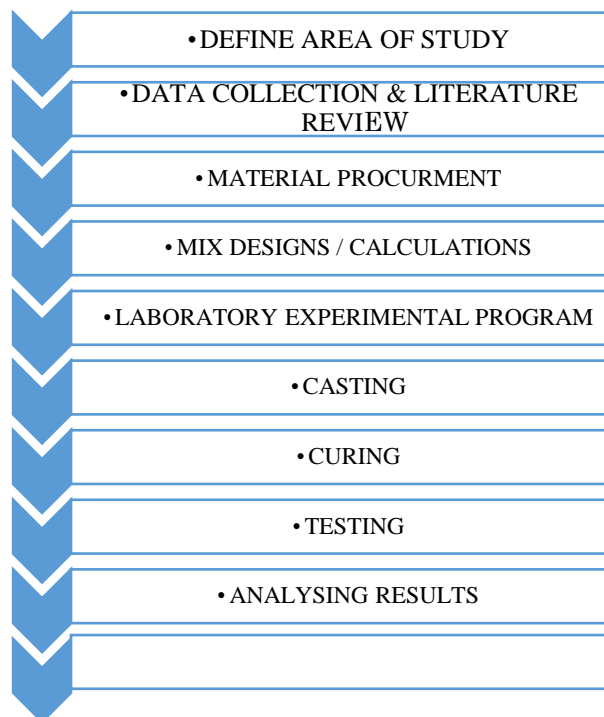
1. Studying the effect on setting time of concrete by adding sugar in various percentages.
2. By adding sugar as admixture in 0.%,

0.05%, 0.1%, 0.15%, 0.2% and 0.25% by Weight of cement comparing the increased compressive strength to the standard strength of concrete.

3. Evaluation of Economy of the sugar with reference to admixtures available in market.

### METHODOLOGY

The Methodology adopted carried out is presented in the form of flow chart After identification of problem and setting the objectives of the research, the research methodology has carefully design to achieve above mentioned objectives also the sequential activities involved in this study are presented in graphical form.



## EXPERIMENTAL PROGRAM

Experimentation was carried out to investigate the following: The proportion of sugar used along with the cement in the study is 0.0%, 0.05, 0.1, 0.15, 0.2 and 0.25%, respectively. In order to determine consistency, initial setting time and final setting time by vicat apparatus. The workability and compressive strength were done with slump test and compressive testing machine respectively.

## MATERIALS

### Cement

OPC 53 Grade ordinary Portland cement (Vasuvdatta cement) conforming to IS: 12269 is used. The Specific gravity of the cement was 3.12, the initial and final setting times were found as 90 minutes and 280 minutes respectively [5-8].

### Fine Aggregate:

Crush sand passing through 4.75 mm IS Sieve was used. The specific gravity of the sand was found as 2.62.

### Course - Aggregate:

Aggregate available from local sources has been used. The size of coarse aggregate was 20mm and 10mm with its specific gravity was 2.68.

### Water:

Tap water that is suitable for making ordinary concrete is used (Potable Water)

### Admixtures

Sugar was used as admixture in the concrete production. White crystalline solid readily soluble in water and available in market was used in the experimentation work. Sugar was added in concrete composition with three different dosages as 0, 0.05, 0.1, 0.15, 0.2 and 0.25% by weight of cement. Fig: 1 shows the sample of Sugar



*Fig: 1 Sample of Sugar*

## MIX PROPORTION

Nominal proportions are selected for the concrete mix of M<sub>20</sub> grade as per IS 10262-1982 and it was 0.50: 1: 1.50:3.00 (W: C: FA: CA) by weight. For better workability, aggregates were used as 60 % & 40% of 20 mm, 10mm respectively and fine aggregate of zone II are selected. In this Experimental work, the main object is to evaluate the behaviour of concrete in compress by adding Sugar as admixtures into the concrete. Sugar is added by weight of cement as 0, 0.05, 0.1, 0.15, 0.2 and 0.25% into the concrete.. For every dosage of admixture, slump cone tests are performed to record the workability of fresh concrete. Among these three numbers of cube specimens are tested for determining the 7 days compressive strength and three specimens are used for determining the 14 days tests and three specimens are used for determining the 28 days tests

## OVERVIEW ON PROPERTIES OF THE CONCRETE:

### Workability

The workability of fresh concrete is a composite property. IS: 6461 (Part-VII) – 1973 defines workability as the property of freshly mixed concrete which defines the ease and homogeneity with which it can be mixed, placed, compacted and finished. Workability of concrete is also depending on the type structure, thickness of structural element and place of casting.



**Fig. 2** Slump Showing the workability of Concrete

**Compressive strength**

9 cube specimens of each percentage (0, 0.05, 0.1, 0.15, 0.2 and 0.25%) are casted according to the nominal mix proportion and the size of cube specimen was 150 mm x 150 mm x 150 mm. According to the IS: 10086-1982, cube moulds are used for experimental work. Specimens are casted in cube mould and filled with concrete in three layers. Hand compaction is done with tamping rod and de-moulded after 24 hrs. Specimens are marked with marker and allowed to dry for some time and immersed in the curing tank. De-moulding of cube specimen is difficult after 24 hrs. for specimens casted with admixture of 0.05% and 0.1% because of extension of setting time. Specimens casted with 0.05% and 0.1% admixture were de-moulded after 48 hrs. and for 0.15, 0.2 and 0.25% after 72 hrs. The specimens are kept into the curing tank for curing @ temp  $27 \pm 2^\circ$  for a period of 28 days. After completion of curing period, specimens are removed from curing tank, kept for drying and tested in UTM. Fig: 3 show the casted cube specimens. During the experimentation of casting, it is clearly observed lower ranking of bleeding and segregation.



**Fig:3** Casted cube specimens

**TEST SETUPS:**

**For determination of Workability:**

Workability of concrete has been measured by performing slump cone tests. Mix the material of concrete properly on a water tight plat form and measure the slump cone value as stated in the above section 5.1 and record the values, tabulated properly. During the testing of slump value, it was clearly observed that collapse of slump, when admixtures added at variation of 0.05 and 0.1, 0.15, 0.2, 0.25%.

**For Determination of Compressive strength:**

Remove the cube specimens from the curing pond after appropriate period of 7 days, 14 days and 28 days and allow drying in for about some time. Take the weight of the each sample and place the specimen opposite direction of casting in UTM. Check whether the surface of specimen contact to the upper arm of the UTM or not. Apply load uniformly and record the ultimate load. Testing of specimen has been shown in Fig 4.



*Fig: 4 testing of cube specimen.*

**EXPERIMENTAL RESULTS AND TABLES**

**Workability of concrete with Sugar :**

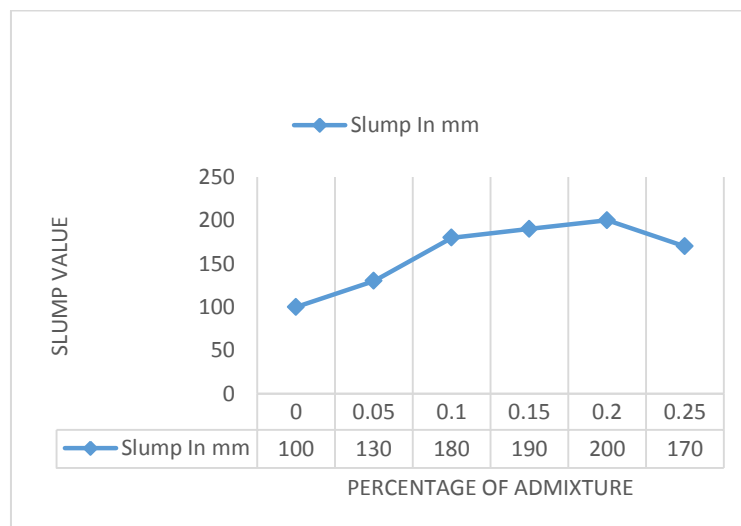
Addition of Sugar to the concrete greatly influenced the setting property and clear collapse of slump witnessed during the experimentation. Setting of cubes specimen after 24 hrs. is difficult. During the de-moulding after 24 hrs. Cube specimens are found cracks. So, de-

moulding of specimens carried out after 48 hrs. for 0.05, 0.1% of admixture and 72 hrs. for 0.15, 0.2,0.25%.The basic reason for extending the setting of time is adsorption of sugar acted as thin layer over the cement particles and it slows down the hydration process. Formation of calcium ions is increase the solubility and discouraging the formation of calcium hydroxide. By this reason setting property of concrete has been improved.

*Table1:Workability of concrete with Sugar as admixture.*

S. No	Admixture	% of Admixture by wt of Cement	Slump value in mm
1	Sugar	0	100
2		0.05	130
3		0.1	180
4		0.15	190
5		0.2	200
6		0.25	170

Concrete specimens with sugar as admixture exhibited better workability. Fig 5 gives the graphical representation of slump value.



*Fig 5: Slump value of concrete with added Admixtures.*

**Compressive strength of concrete with sugar as admixtures:**

Based on the test results, as percentage of admixture increases from 0 to 0.10% the compressive strength of concrete also increased. Maximum strength of concrete is related on workability of concrete and it can be achieved by high degree of workability. The compressive strength of

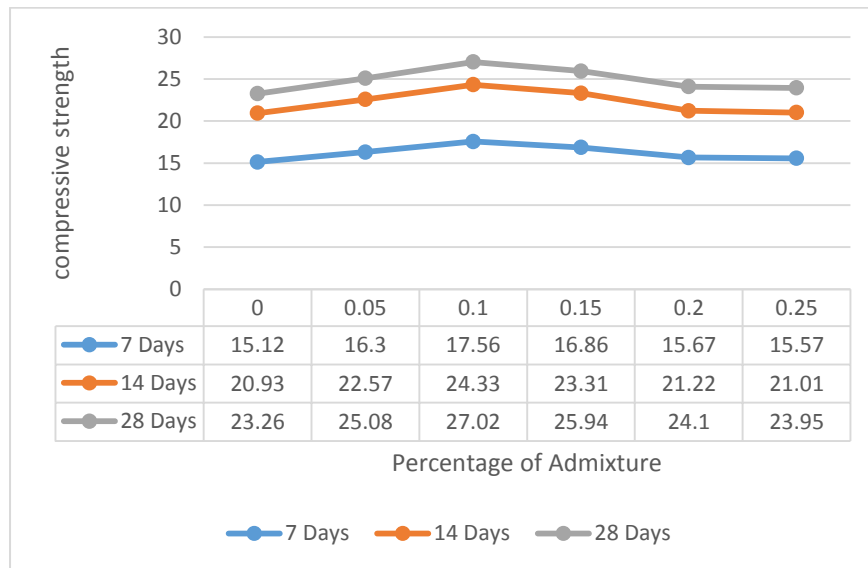
concrete measured for admixtures after 7, 14 and 28 days. From table 2 and 3 it is clear that, as the percentage of admixture increased, the compressive strength increased. The only reason for improvement of strength is bonding. Sugar had good bonding property. After 28 days, the percentage of variation between the conventional concrete and concrete with



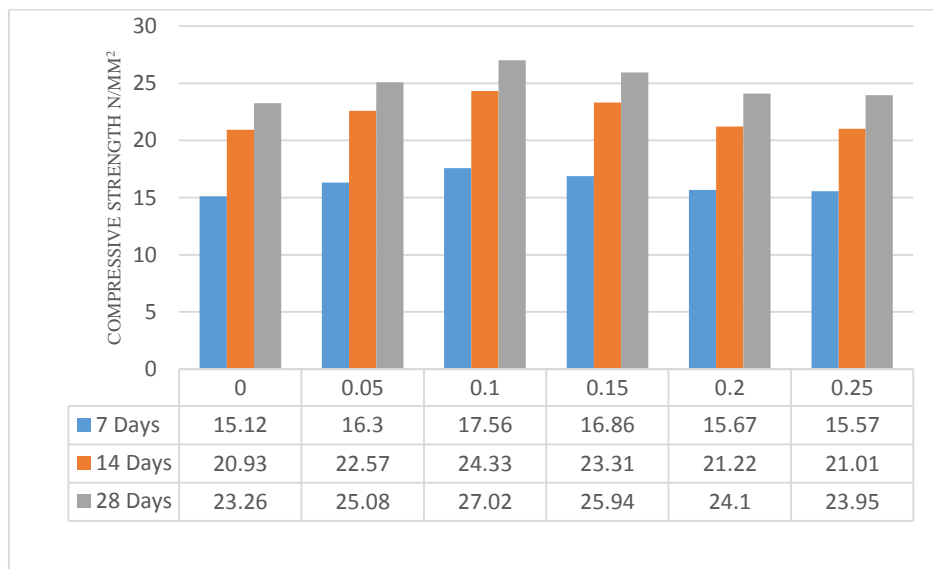
0.1% of sugar added as admixture was are represented in fig 8 and 9. 12.0%. The compressive strength values

**Table 2: Compressive strength of concrete with Sugar added as Admixture.**

S.No	Percentage of admixture	Density of concrete in Kg/m <sup>3</sup>	7 days compressive strength in Mpa	14 days compressive strength in Mpa	28 days compressive strength in Mpa
1	0	2456.7	15.12	20.93	23.26
2	0.05	2488.0	16.30	22.57	25.08
3	0.1	2498.2	17.56	24.33	27.02
4	0.15	2499.1	16.86	23.31	25.94
5	0.2	2501.2	15.67	21.22	24.10
6	0.25	2510.5	15.57	21.01	23.6



**Fig 6: Compressive strength of concrete with Sugar as admixture.**



**Fig 7: Compressive strength of concrete with Sugar as admixture.**

**Table 3: Initial and Final Setting time of Cement with addition of different percentage of admixture.**

No	% of Sugar addition by wt of Cement	Initial Setting Time (Mins)	Final Setting Time (Mins)
1	0	120	349
2	0.05	179	410
3	0.1	345	593
4	0.15	248	491
5	0.2	174	316
6	0.25	112	294

### CONCLUSIONS

The test carried out at 3 days , 7 days, 14 days and 28 days, the comparison is made between the varying proportions 0%,0.05%,0.1%,0.15%,0.2%,0.25% of addition of sugars in concrete mix for Setting time ,Workability & Compressive strength. From the result it is clear that a change in the properties of concrete take place. When sugar is mixed with concrete.

- Workability increased when the dosage of admixture was increased.
- Collapse of Slump was observed in both the admixtures at a dosage of 0.1%.
- The setting time of concrete increase sugar with increase the percentage of sugar.
- The compressive strength increases as the dosage of the sugar increases as compared to ordinary concrete as 0.1% addition of sugar shows maximum results further addition gives the fluctuations in the results and the setting time, workability affects a lot.

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