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EFFECT OF SUGAR ON THE COMPRESSIVE STRENGTH OF CONCRETE

Zeeshan Ahmed[*1], Samar Hussain Rizvi[*2], Aneel Kumar[*3]

[*1,2,3]Department Of Civil Engineering, Mehran UET, Jamshoro, Sindh, Pakistan.

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ABSTRACT

Global Warming is a major alarming concern which significantly affect the fresh and hardened properties of concrete. As sustainable construction practices gain importance, investigating alternative admixtures becomes essential. Organic retarding admixture like table sugar (sucrose $C_{12}H_{22}O_{11}$) have a versatile use in a current concrete industry. For this research work, locally available table sugar in a fine powdered form was utilized and the nominal mix of M20 grade concrete with 1:1.5:3 at 0.52 water to binder ratio was prepared using 0%, 0.02%, 0.04%, 0.06%, 0.08% and 0.1% of sugar by weight of cement to examine the effect of sugar on the compressive strength of concrete. The results indicated that the inclusion of sugar improved compressive strength of concrete by 9.99% at 0.02% of sugar by weight of cement.

Keywords: Sugar, Admixture, Concrete, Compressive Strength.

I. INTRODUCTION

Concrete is widely used structural material across the world which is mainly composed of cement, fine aggregate, coarse aggregate and water. Water is the important source to initiate hydration reaction of cement with aggregate to form rock like mass called concrete. Recent changes in a weather condition have brought concrete to set earlier which interrupts the concrete to transport, place and compact in a particular time period. Due to rise in temperature, concrete industry requires retarding admixtures to regulate setting time of concrete. Organic admixture like sugar nowadays widely utilized across the globe for its properties like retarder, economical, longer shelf life and eco-friendly. Sugar can be extracted from many sources but sugar cane is the major source.

Azad A et al. (2020), has carried out research on effect of sugar on different properties of concrete. They adopted 0, 0.01, 0.02, 0.03, 0.04, 0.05, 0.06, 0.08, 0.1, 0.2 and 0.3% of sugar by weight of cement. It was observed that setting time was increased till 0.08% sugar and workability was continuously increased. It was also found out that 0.08% was the optimum percentage for compressive strength of concrete [1]. Aziz A (2021), has used sugar and jaggery and replaced some of its percentages with ash and examined that setting time and workability was increased but jaggery gave better results than sugar, true slump was observed at 0.25% and collapse slump was observed at 0.75% of jaggery. Flexural strength was decreased up to 50% [2]. Shah and Kadam (2018), had carried out experimental investigation on the effect of sugar and jaggery on workability and compressive strength of concrete. They adopted 0% and 1% of sugar and jaggery by weight of cement and found that workability was increased about 14.02% with sugar and 26.17% with jaggery. Compressive strength also increased about 4.66% with sugar and 6.13% with jaggery at 28 days of curing and it was concluded that jaggery gave better results [3]. Kumar A et al. (2015), analyzed the effect of sugar, jaggery and sugar cane ash on properties of concrete. They selected various amounts of materials such that 0, 0.025, 0.05, 0.075, 0.10 and 0.125%. It was observed that setting time and workability increased and compressive strength was enhanced in jaggery more than sugar. The optimum percentage which was 15% replaced with sugar cane ash gave best strength result about 8.93% increased [4]. Qureshi F et al. (2017), worked on strength of concrete by adding jaggery and adopted 0, 0.1, 0.2, 0.3, 0.4% of jaggery by weight of cement and found that workability was increased by 49.33% and compressive strength was increased at 0.1 and 0.2% but decreased at 0.3 and 0.4% of jaggery. Flexural strength expanded at 0.1 and 0.2% of jaggery. Tensile strength was increased at 0.1% of jaggery [5].

This research explores the potential benefits of incorporating sugar into concrete mixes, with a particular focus on its influence on compressive strength. By investigating the advantages and limitations of this additive, this research aims to contribute valuable insights to the field of construction engineering. The application of sugar shows promises in optimizing concrete performance and adapting it to various construction requirements. This

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study endeavors to provide a comprehensive understanding of its roles in improving concrete properties, thereby contributing to the advancement of sustainable and efficient building practices.

II. METHODOLOGY

This research study followed a well-structured methodology to systematically investigate the influence of sugar additive on compressive strength of concrete. Various percentages of locally available sugar were utilized as an additive in concrete by weight of cement to examine the effect of sugar on the compressive strength of concrete. Nominal mix of M20 grade concrete with 1:1.5:3 at 0.52 water to binder ratio was adopted. For concrete preparation, standard cement, well graded aggregates, water, as well as sugar, each chosen for their potential impact on concrete performance. To facilitate its integration into the concrete mix, sugar was prepared as aqueous solution. The experimental procedure involved the formulation of distinct concrete batches with varying levels of this additive. Sugar used in fine powdered form as shown in figure below.

Figure 1: Sugar

Various percentages of sugar utilized in research work is shown in table below.

Table 1: Percentages of Sugar

S. No.	Mix ID	Percentages of sugar (%)
1	C (Control Mix)	0 %
2	S1	0.02 %
3	S2	0.04 %
4	S3	0.06 %
5	S4	0.08 %
6	S5	0.1 %

Test performed on concrete is discussed below.

COMPRESSIVE STRENGTH

Compressive strength test was conducted as per BS EN 12390-3 code using 100 mm concrete cubes as shown in figure below.

Figure 2: Compressive strength test

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III. RESULTS AND DISCUSSION

The results of the research work are discussed below.

COMPRESSIVE STRENGTH

Results of compressive strength test on hardened concrete cubes (100 mm × 100 mm × 100 mm) containing sugar by weight of cement at various level of percentages are discussed below in table and graph.

Table 2: Compressive strength of concrete results

S. No	Mix ID	Percentages of sugar (%)	Average Compressive Strength at 7 days of curing (MPa)	Average Compressive Strength at 28 days of curing (MPa)
1	C (Control Mix)	0 %	18.91	24.23
2	S1	0.02 %	22.43	26.65
3	S2	0.04 %	21.82	26.28
4	S3	0.06 %	20.62	25.46
5	S4	0.08 %	20.45	24.69
6	S5	0.1 %	20.15	23.84

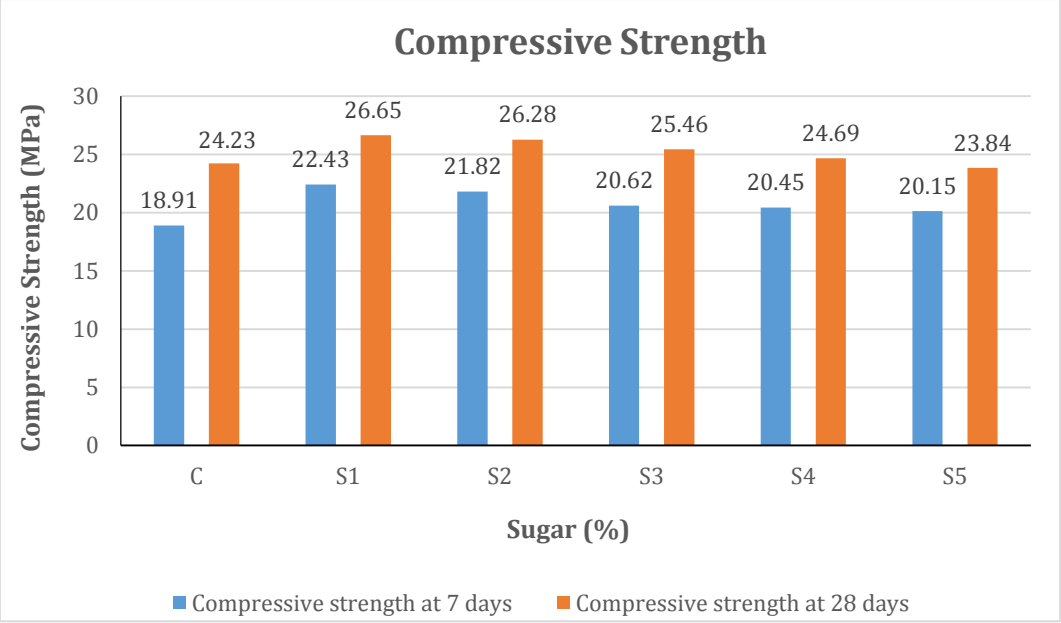

Figure 3: Compressive strength of concrete graph

It can be observed that compressive strength of concrete increased at S1 and then decreased till S5.

IV. CONCLUSION

Here are the conclusions that can be drawn from this research.

1. The maximum compressive strength of 26.65 MPa of concrete was achieved at 0.02% (S1) of sugar by weight of cement that was 9.99% more than the control mix.

2. The addition of sugar to concrete led to a notable improvement in concrete's compressive strength. Among the various percentages examined, the most favorable result in terms of compressive strength was attained by introducing 0.02% sugar.

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