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"USE OF SILICA FUME AS A PARTIAL REPLACEMENT OF CEMENT IN CONCRETE"

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ABSTRACT

In recent years, there are many attempts on improving properties of concrete for more strength and durability. Silica Fume and other industrial hydro-products can be used to improve the strength and water permeability of OPC. In this experiment, we're using silica fume to replace 20, 25, and 30% of the cement. The main goal is to compare the difference between concrete with less percentage of silica fume and high percentage of Silica Fume. Our future goal is to analyze that the concrete with high percentage of silica fume which is of 20% , 25% , 30% will be satisfied with the test performed on it.

INTRODUCTION

High workability, high density, excellent modulus of elasticity, high dimensional stability, superior abrasion and impact resistance, and high strength and cavitation resistance are all reasons for OPC's appeal. To achieve economic advantages with sustainable construction there are a number of cementitious materials like silica fume and fly ash are commonly used in cement production. OPC is often used to mobilise their pozzolanic effect, which increases the strength, workability, durability, fracture resistance, and permeability of the material. "Concrete that fulfils unique performance and homogeneity standards that cannot always be accomplished routinely using ordinary constitutional and typical mixing, putting, and curing methods," according to the American Concrete Institute.

Silica fume is an oxidised vapour produced in electric furnaces during the formation of silicon metal and ferrosilicon alloy. Silica fume is an ultrafine powder with a surface area of 13,000 to 30,000 m2 per kilogramme with particles that are 100 times smaller than normal cement particles.

The majority of the rigorous study is spent on compressive strength and rebound No. though the literature regarding silica fume seems to be reached. It is there for necessary to investigate the strength property like compressive strength and flexural strength test on beam which is characteristic of ordinary Portland cement (OPC). This type of concrete is employed in a variety of projects because it is cost-effective, durable, and safe.

BACKGROUND

Because of the escalating cost of materials used in concrete and the environmental concern caused by cement manufacturing, several researchers have been attempting to replace the ingredient of concrete with a low-priced, locally accessible alternative. As a result, the special cementitious materials are gaining popularity. The use of additional cementatious material has been significant in the past and may continue to be so in the future.

Smelting silicon metal and ferrosilicon alloy produces silica fume, which is used as a secondary cementing material. It may include more than 85% SiO2. The high amount SiO_2 content makes it highly reactive pozzolanic material

MATERIALS

1. **Cement:** we used ordinary Portland cement (OPC) in this present study. It is generally created from limestone and was evolved from other forms of hydraulic lime.

2. **Aggregate:** Construction aggregate is a general term for coarse- to medium-grained particulate construction material.

3. **Silica fume:** Xetex industries Pvt. Ltd. , Bhivandi supplied us the silica fume. This research utilized a grey-colored silica fume.

4. **Sand:** We have used crushed sand in this research.

MIX PROPORTION

The materials utilised in this study are readily available in the market. In this study, OPC is employed, which is partially substituted with Silica Fume (up to 20%, 25%, and 30%). Concrete mix proportion of 1:1:2 by volume was used in this result. The ratio of binding material in

the concrete mix is 1:1:2. (Cement: sand: aggregate). The concrete samples are cured for 7 days. In the mix cement was used as binder called control mix and was partially replaced by silica fume different weight percentage (20%, 25%, 30%). Table no.1 provides information on concrete mix variations and designations.

Table 1: MIX PROPORTION

Sr. no	Cement (grams)	Silica fume (total percentage replaced)	Fine Aggregate	Coarse Aggregate	Water (gram)	W/B ratio
1	1440	20	1800	3600	745	0.55
2	1333	25	1800	3600	745	0.55
3	1260	30	1800	3600	745	0.55

RESULT AND DISCUSSIONS:

REBOUND HAMMER TEST:

Rebound Hammer gives us surface strength of the specimen. During the test we have to take 16 reading in which first 3 and last 3 readings are not taken into account. When the plunger is forced into the concrete surface, a spring-controlled mass in the schmidt hammer rebounds. The quantity of rebound depends on the hardness of the concrete surface.

Table 2: Rebound hammer test results.

Percentage of silica fume	7 Days Specimens		28 Days Specimens	
	Rebound NO.	Compressive strength by graph	Rebound NO.	Compressive strength by graph
20%	25	21	27	24
	22	18	26	22.5
	24	20	25	21
25%	20	15	23	19
	22	18	24	20
	24	20	26	22.5
30%	21	17.5	24	20
	23	19	21	17.5
	22	18	22	19

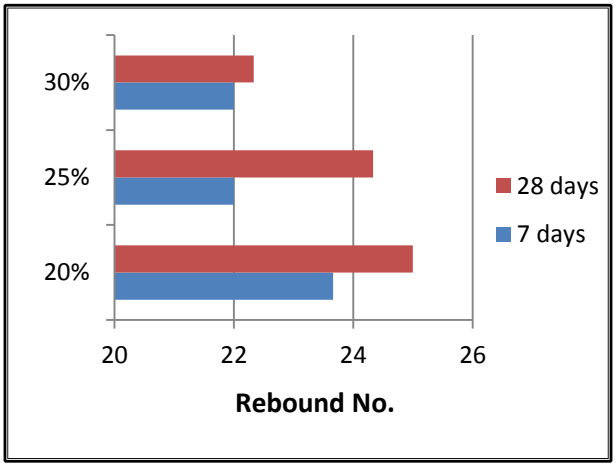

Fig 1: Rebound hammer test results.

COMPRESSIVE STRENGTH TEST:

7-day concrete samples with different percentage of silica fume as a substitution of cement were analyzed for compressive strength. The percentages of cement replaced by silica fume were 20%, 25%, and 30%, respectively. Three samples of each replacement were tested and average of this samples of compressive strength of concrete were observed. In this research mixing ratio was 1:1:2. Table no. 3 represents all the result of compressive strength and graph tested on 7 days cubes.

Table 3: Compressive strength test results.

Percentage of silica fume	Compressive strength (kN)	Average (kN)
20%	255	276.33
	300	
	274	
25%	270	236.66
	240	
	200	
30%	195	203.33
	202	
	213	

COMPRESSIVE STRENGTH TEST:

Following table no. 4 shows the results of compressive strength test which is performed on 28 days cured cubes.

Table 4: Compressive strength test results.

Percentage of silica fume	Compressive strength (kN)	Average (kN)
20%	370	403.33
	450	
	390	
25%	260	283.33
	290	
	300	
30%	230	246.66
	260	
	250	

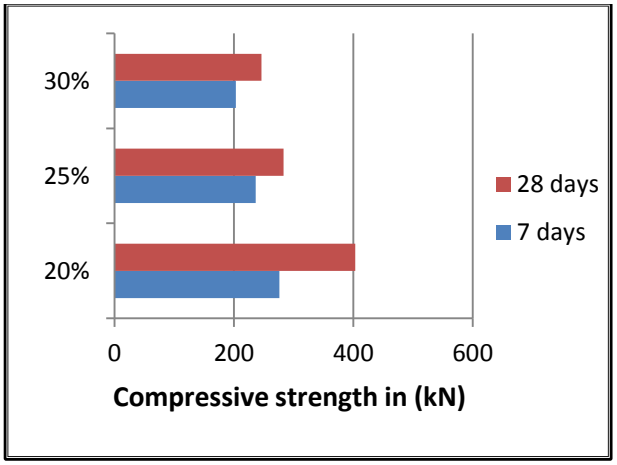

Fig 2: Compressive strength test results.

CONCLUSION

The Following conclusion are drawn from the research based on experimental investigation by using silica fume as partial replacement of cement:

- From experimental work it is observed that 7 day strength of cube decreased as percentage of silica fume increased when used as partial cement replacement.
- By doing Rebound hammer test we came to know that the cubes which were tested are fair category cubes.
- It is concluded from analysis that silica fume used as partial replacement of cement have pozzolanic material and properties like compressive strength have good result and can contribute in hydration process.

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