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Study on Structural Behavior of Fumed Silica in Concrete

K. Ayyappan and K. Thiruvenkatasamy
Department of Harbor and Ocean Engineering, AMET University, 135 East Coast Road,
Kanathur, 603112 Chennai, India

Abstract: Concrete is the important construction material used in the construction of all over engineering, it is a economic material and it is widely available in nature. Due to the rapid usage and fast construction development in all over the world, the shortage of natural aggregates (fine and course aggregate). The replacement of fine aggregate and course aggregate with waste materials. In this study, fine aggregate was replaced by fumed silica with various percentages of 0, 5, 10 and15%.

Key words: Fumed silica, concrete, structural behaviour, material, nature, aggregate

INTRODUCTION

Fumed silica is increase the strength of concrete by using in concrete. Fumed silica is a heat resistance material thus, it prevents the formation of cracks. Micro silica on the strength of concrete and strength of reactive fumed silica powder concrete are discussed by Ajay *et al.* (2012) and Mithaq and Louis (2010). With the increase in construction activities, there is heavy demand on concrete and consequently on its ingredient like aggregate also. Application and usage of foundry sand is explained by Attar and Gupta (2016) and Bhandari and Tajne (2016). However, the objective of the project is to study and compare the strength behavior of concrete using fumed silica as a partial replacement of fine aggregate. Sand stone resistivity is described by Prince and Jefferson (2014) (Fig. 1).

Fig. 1: Fumed silica

MATERIALS AND METHODS

The different diaries were gathered and examined on the halfway substitution of the coarse total by various materials. As per these diaries the procedure of the analysis and the strategy for the experimentation and the diverse tests directed in those diaries were considered and learned. On the premise of the investigations of the diaries gathered for the examination the test technique for the venture was pick.

As indicated by the strategy taken after for the venture, the materials were gathered for the examination, the preparatory tests were directed to the materials to know the properties, for example, particular gravity, fineness modulus and the water ingestion. In view of these properties the outline blend was done to know the amount of the materials required for the M25 grade concrete.

The examples with the three unique rates of the halfway substitution of fine total by fumed silic for example, 5, 10 and 15% alongside the control examples. The compressive, split and flexural qualities of the examples were tested (Table 1 and 2).

Table 1: Physical property of fumed silica

Description	Values
Fumed silica S.G	2.49
Bulk density	2592 (kg/m^3)
Water absorption	0.43 (%)
Moisture content	0.1-9.8
Clay lumps and friable Particles	1-42
Coefficient of permeability	10-3-10-6 (cm/sec)
Plastic limit	Non-plastic

Corresponding Author: K. Ayyappan, Department of Harbor and Ocean Engineering, AMET University, 135 East Coast Road, Kanathur, 603112 Chennai, India

Table 2: Chemical properties of fumed silica

Constituent	Values (%)
SiO_2	67.22
Al_2O_3	4.27
Fe_2O_3	7.31
Ca O	0.16
Mg O	0.24
SO_3	0.87
Na_2O	0.47
K_2O	0.48
P_2O_5	0.00
Mn_2O_3	0.12
SrO	0.19
TiO_2	0.48
Loss on ignition	16.25

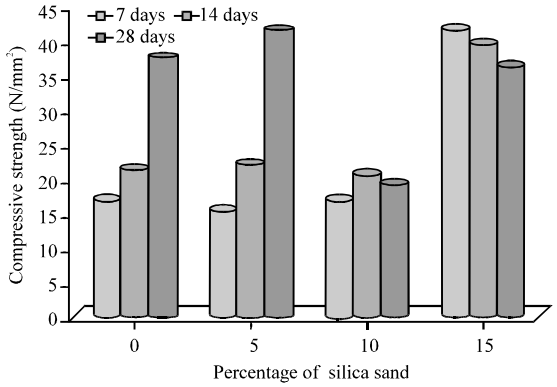

Fig. 2: Comparison of compressive strength of cubes

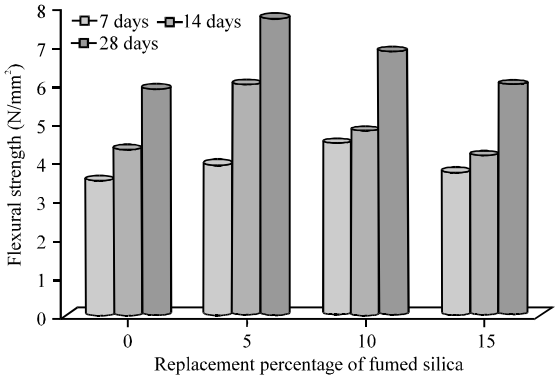

Fig. 3: Flexural strength of beams

RESULTS AND DISCUSSION

From Fig. 2, the partial replacement of fine aggregate by fumed silica with various percentages in concrete has following conclusion. The maximum flexural strength for partial replacement of fine aggregate with fumed silica be achieved by 5% is found to be greater than the conventional concrete. It achieved maximum compressive strength when there is partial replacement of fine aggregate with fumed silica (5%). So, the optimum percentage of replacement of fumed silica is 5% (Table 3 and 4) (Fig. 2 and 3).

Table 3: Test results cubes for compressive strength

	Average compressive strength (N/mm^2)			
		Fumed silica concrete		
Number of curing days	Conventional concrete	5 (%)	10 (%)	15 (%)
7	16.88	15.23	16.71	14.66
14	21.24	22.01	20.45	18.98
28	37.72	41.36	39.24	36.19

Table 4: Test results beam for flexural strength

	Average compressive strength (N/mm^2)			
		Fumed silica concrete		
Number of curing days	Conventional concrete	5 (%)	10 (%)	15 (%)
7	3.46	3.90	4.46	3.70
14	4.28	5.96	4.77	4.12
28	5.86	7.67	6.83	5.97

CONCLUSION

Compressive quality, split elasticity and flexural quality of solid examples expanded with increment in fine total substitution by foundry sand, giving most extreme quality at 5% substitution and past that the quality parameters demonstrated a decrease in their separate esteems. The expansion in quality parameters might be because of fineness of the foundry sand. The foundry sand fineness is higher than fine total and decreases the permeable nature in concrete subsequently, expanding thickness and quality. Be that as it may, diminishment in compressive quality of solid example with substitution rate past 5% is ascribed to covers exhibit in foundry sand, made out of fine powder of earth and carbon which brings about a feeble security between bond glue and total. The supplanting of common sand with utilized foundry sand up to 5% is alluring as it is practical, decreases the measure of virgin fine total, diminishes arrive fill issues and jam nature. Making solid utilizing reused materials (foundry sand) spares vitality and save essential assets and it is inferred that the more material was reused, the less assets were devoured which prompts a sheltered, maintainable condition.

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