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Research paper

Experimental Investigation on Rcc by Using Multiple Admixtures

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Abstract:

In this article, the effect of replacing cement with silica fume and fine aggregate with copper slag has been investigated. For this research work, concrete of M40 grade is prepared and evaluated for fresh and harden concrete properties such as compressive strength, tensile strength and flexural strength. Further, the cement is replaced with silica fume at 0, 2, 4, 6, 8 and 10 % and fine aggregate replaced with copper slag at 0, 10, 20, 30, 40 and 50 %. Compressive strength, strength and Flexure strength have been tested. It is observed from the results that the use of silica fume and copper slag as partial replacement material improves mechanical properties of the concrete. Concrete with 40 % copper slag and 8 % silica fume shows better performance among all the mixes.

Keywords: *Copper Slag, Silica Fume.*

1. Introduction

Concrete is the most widely used building material which resists predominantly compressive forces. By addition of pozzolanic materials, the properties like workability, durability, strength, resistance to cracks and permeability of concrete can be improved. Modern concrete mixes are modified with addition of admixtures. The subsequent modification of the micro structure of cement composites improves the mechanical properties. Silica fume which is used commonly in cement and contain 85 to 98% silica. Silica fume does not have any cementitious properties but when reacts with calcium hydroxide on hydration of cement produces calcium silicate hydrate gel, which gives good cementitious properties. As for chemical reaction of silica fume, because of high surface area and high content of amorphous silica in silica fume, this highly active pozzolona reacts more quickly than ordinary pozzolonas. The silica fume used in concrete has engineering potential and economic advantage. The use of silica fume , Silica fume will make concrete less permeable and high strength, but it will not change unit weight. This work represents the effect of silica fume on fresh and hardened concrete. Silica Fume is highly effective pozzalonic material. Copper slag is an industrial by-product produced from the process of manufacturing copper. The use of copper slag in production of concrete as replacement for cement can reduce the costs of disposal and helps in protecting the environment.

2. Experimental Investigation

Materials

Cement

Cement confirming to IS: 1489:1991 from Dalmia cement was used and the properties are as shown in Table 1.

Table1. Properties of cement

Property		Results
Standard consistency		33%
Specific gravity		3.10
Fineness		0.85%
Setting time	Initial	120 minutes
	Final	310 minutes
Compressive strength	3 day	24.4 MPa
	7 day	35.1 MPa
	28 day	53 MPa

Fine Aggregate

Fine aggregate used in this study is from the locally available crushing unit and conformed to zone II as per IS: 383-1970.

Table 2. Properties of fine aggregate

Properties	Results
Fineness modulus	3.83
Specific gravity	2.7
Water absorption	0.4%

Coarse Aggregate

The coarse aggregate used in the experimentation were of 20 mm and down size aggregate and conforms to IS: 2386-1963 (Part I, II and III) specifications. The properties of coarse aggregates are as shown in Table3.

Table 3. Properties of coarse aggregate

Properties	Results
Specific gravity	2.6
Water absorption	0.8

Copper Slag

The copper slag used in this study is obtained from Sterlite industries, Tuticorn. This material replaces fine aggregate in mix proportion. The copper slag used in this study confirms to zone II. Table 4 and Table 5 show chemical and physical properties of copper slag respectively.

Silica fume

Silica fume used in this study is procured from BSS private limited, Edapally. Silica fume is fine powder, with particles about 100 times smaller than average cement partial. It confirms to IS: 15388-2003.

Table 6. shows the properties of silicafume.

Phisical Properties Of Silicafume	
Particle size typical):	<1 μm
Bulk density :	
(as-produced):	130-430 kg/m^2
(densified):	480-720 kg/m^2
Specific gravity:	2.2
Specific Surface:	15,000 – 30,000 m^2/kg

Concrete mix design for M40 grade

WATER	CEMENT	FINE AGGREGATE	COARSE AGGREGATE
189	497Kg	627.66Kg	1039Kg
0.38	1	1.26	2.09

Adopting mix proportions:

MIX PROPORTION 1: 1.26 : 2.09 :0.38

Mix	Notation
M-0-0	Concrete with 0% SF and 0% CS
M-2-0	Concrete with 2% SF and 0% CS
M-4-0	Concrete with 4% SF and 0% CS
M-6-0	Concrete with 6% SF and 0% CS
M-8-0	Concrete with 8% SF and 0% CS
M-10-0	Concrete with 10% SF and 0% CS
M-8-10	Concrete with 8% SF and 10% CS
M-8-20	Concrete with 8% SF and 20% CS
M-8-30	Concrete with 8% SF and 30% CS
M-8-40	Concrete with 8% SF and 40% CS
M-8-50	Concrete with 8% SF and 50% CS

Page layout Workability of concrete:

Mix	Slump value (mm)
M-0-0	59
M-2-0	57
M-4-0	50
M-6-0	46
M-8-0	40
M-10-0	37
M-8-10	45
M-8-20	52
M-8-30	59
M-8-40	64
M-8-50	68

Workability of the concrete increases in copper slag percentage and decreases with increase in silica fume percentage. Workability is reduced when silica fume is added to concrete.

Compressive strength of concrete:

Mix	Compressive strength
M-0-0	49
M-2-0	51
M-4-0	54
M-6-0	56
M-8-0	58
M-10-0	59
M-8-10	55.3
M-8-20	57.2
M-8-30	59
M-8-40	62
M-8-50	64

The maximum values of mechanical and durability properties are obtained for the mix M-8-40. The percentage increase in compressive strength is 26.53% respectively

Split tensile strength of concrete:

Mix	Split tensile strength
M-0-0	2.85
M-2-0	2.94
M-4-0	3.02
M-6-0	3.11
M-8-0	3.53
M-10-0	3.54
M-8-10	3.52
M-8-20	3.59
M-8-30	3.65
M-8-40	3.76
M-8-50	3.78

The maximum values of mechanical and durability properties are obtained for the mix M-8-40. The percentage increase in Spilt Tensile strength is31.93% respectively

Flexure strength of concrete:

Mix	Flexure strength
M-0-0	6.46
M-2-0	6.58
M-4-0	6.65
M-6-0	7.02
M-8-0	7.82
M-10-0	7.78
M-8-10	7.80
M-8-20	8.01
M-8-30	8.52
M-8-40	8.91
M-8-50	8.70

The maximum values of mechanical and durability properties are obtained for the mix M-8-40. The percentage increase in flexure strength is 37.92% respectively

3 Conclusions:

Replacing cement with silica fume and fine aggregate with copper slag effect is examined in this article. The concluding remarks of the paper are listed below.

Workability of the concrete increases with increase in copper slag and decreases with increase in silica fume. Workability is reduced by adding silica fume as it contains copper slag in place of fine aggregate.

When replacement level of silica fume increases all the mechanical properties are increased up to 8% and up to 40% replacement level of copper slag all the mechanical properties are increased.

The maximum values of mechanical and durability properties are obtained for the mix M-8-40. The percentage increase in compressive strength, Spilt Tensile strength and flexure strength are 26.53%,31.93% and 37.92%respectively.

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