An Expeimental Study on Micro Silica Concrete

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ABSTRACT

In India, there is great demand of aggregate in Civil Engineering Industry especially for road and concrete construction. Now a day the availability of fine aggregates becomes a major problem. – In India, there is great demand of aggregate in Civil Engineering Industry especially for road and concrete construction. Now a day the availability of fine aggregates becomes a major problem .The use of micro silica had major impact on industries, ability to routinely and commercially produce silica fume modified concrete of flow able in nature but yet remain cohesive, which in turn produces high early and later age strength including resistant to aggressive environments. Adjusting the mix design with partial replacement can enhance the workability of concrete, making it easier to place and finish.High performance concrete appears to be better choice for a strong and durable structure. A large amount of by-product or wastes such as fly-ash, copper slag, silica fume etc. are generated by industries, which causes environmental as well as health problems due to dumping and disposal.

1.INTRODUCTION

Concrete is used in gargantuan amount almost all around the world over human race has a requirement for organization. For the preparation of concrete, we need cement, fine aggregate and coarse aggregate. The fine aggregates come from river sand which is natural resource.

polymer wastes by using this process we can make concrete cost-effective by replacing waste materials through fine aggregates. As our country is a developing country, we need to preserve our natural resources for our future generation. Micro Silica, also known as micro silica is an amorphous (non-crystalline) polymorph of silicon dioxide. It is extremely fine with particles size less than 1 micron and with an average diameter of about 0.1 microns, about 100 times smaller than average cement particles. Its behavior is related to the high content of amorphous silica (> 90%). Silica fume is also known as micro silica or condensed silica fume, is used as an artificial pozzlanic admixture. It is a material resulting from reduction of quartz with coal in an electric arc furnace in the manufacture of silicon or ferrosilicon alloy.Chemical composition of silica fume Contains more than 90 percent silicon dioxide Other constituents are carbon, Sulphur and oxides of aluminum, iron, calcium, magnesium, sodium and potassium.The physical composition of silica fume Diameter is about 0.1 micron to 0.2 microns, Surface area about 30,000 m^2/kg and Density varies from 150 to 700 kg/m^3.While replacing the cement the care should be taken that the strength of concrete is not reduced. The micro silica also known as silica fume or condensed silica fume is the good replacement of cement in the concrete mix design. The silica fume is a by product of silicon and ferrosilicon alloy production. It is an ultra fine powder.

SCOPE

The scope of this project is consumption of cement can be reduced significantly without compromising performance characteristics of concrete including durability. The scope of study is to establish the objectives and this project will be mainly concentrated on experimental works.

ADVANTAGES

Micro silica is often a by product of silicon metal or ferrosilicon alloy production processes, making it a sustainable material choice for concrete production. It reduces the permeability of concrete to chloride and water intrusion considerably. Additionally, the enhanced durability and reduced maintenance requirements of structures built with micro silica can result in long-term cost savings. It increases the value of modulus of elasticity.

METHODOLOGY

- Title Selection
- Literature Review
- Materials Collection
- Materials Testing
- Mix Design
- Replacement of Fine Aggregate with Micro Silica
- Curing of Specimen
- Testing of Specimen
- Result
- Conclusion

MATERIALS CHARACTERISTICS

Cement - Cement is a fine, soft powder used as a binder because it hardens after contact with water. It is produced from a mixture of limestone and clay. OPC cement are using 53 grade cement for concrete.

M Sand - The full form of M sand is Manufactured Sand. This is an artificial type of sand formed by crushing rocks or granite. It is used as a substitute of river sand. M-sand can be used for construction of walls with a cement to sand ratio of 1:3.

Coarse aggregate - Coarse aggregates are a construction component made of rock quarried from ground deposits. The usual range employed is between 9.5mm and 37.5mm in diameter Typically the most common size of aggregate used in construction is 20mm.

MICRO SILICA - Micro Silica is an ultrafine material with spherical particles less than 1μm in diameter, the average being about 0.15μm. This makes it approximately 100 times smaller than the average cement particle.

Fig.1 MICRO SILICA

CopperMineral additions which are also known as mineral admixtures have been used in Portland cement for many years. There are two types of additions which are commonly mixed into the Portland clinker or blended directly with cement these days. They are crystalline, also known as hydraulically inactive additions and pozzolanic, which are hydraulically active additions.

Water - Water is the key ingredient, which when mixed with cement, forms a paste that binds the aggregate together. The water causes the hardening of concrete through a process called hydration.

2.LITERATURE REVIEW

Amudhavalli& Mathew (2012) studied the Effect of silica fume on the strength and durability characteristics of concrete.The main parameter investigated in this study is M35 grade concrete with partial replacement of cement by silica fume by 0, 5, 10,15and by 20%. a detailed experimental study in Compressive strength, split tensile strength, flexural strength at age of 7 and28 day was carried out.Results Shows that Silica fume in concrete has improved the performance of concrete in strength as well as in durability aspect. [1]

Shanmugapriya &Uma (2013) Experimental Investigation on Silica Fume as a partial Replacement of Cement in High Performance Concrete.The concrete used in this investigation was proportioned to target a mean strength of 60 MPa and designed as per A The water cement ratio (W/C) adopted was 0.32 and the Super Plasticizer used was CONPLAST SP 430.Specimens such as cubes, beams and cylinders were cast for various mix proportions and tested at the age of 7,14and 28 days CI 211.4R-08.The investigation revealed that the partial replacement of cement by silica fume will develop sufficient compressive strength, flexure strength and split tensile strength for construction purposes. The optimum dosage of silica fume found to be 7.5% (by weight), when used as partial replacement of ordinary Portland cement. [6]

Hanumesh, Varun and Harish (2015) In this study it is observed the mechanical properties of concrete when partial replacement of cement is done with micro silica. The main aim of this work is to study mechanical properties of M20 grade concrete when cement is replaced with silica fume at different percentages (5,10,15 and 20). The results showed that strength of concrete is increased when 10% replacement of cement is done with micro silica. Above 10% replacement of cement with silica fume it is observed that there is decrease in compressive strength. Hence, optimum percentage of replacement of cement by silica fume is 10% for M20 grade of concrete., Vimala, studied the compressive strength increased with increase in copper slag content up to a replacement level of 10%. Beyond the replacement level of 15% of sand with copper slag in concrete, a decrease in strength was observed. Hence addition of copper slag increased self weight of concrete.

Amarkhail (2015) observed Effects of Silica Fume on Properties of High-Strength Concrete. He found that up to 10% cement may be replaced by silica fume without harming the concrete workability. Concrete containing 10% silica fume replacement achieved the highest compressive strength followed by 15% silica fume replacement with a small difference. Concrete with 15% silica fume content achieved the highest flexural strength.10% and 15% silica fume content as replacement of cement were found to be the optimum amount for significantly enhancement of compressive strength and flexural strength respectively. [10]

Ghutke and Bhandari (2014)The influence of micro silica on concrete was examined in this study. The result showed that micro silica is a good for partial replacement of cement. The strength was increased when cement was replaced with micro silica. Concrete reduces its workability as percentage of micro silica is increased. The optimum compressive strength can be obtained in 10% replacement of micro silica. As strength of 15% replacement of cement by micro silica is more than normal concrete. The optimum cement replacement percentage by micro silica varies from 10% to 15 %.

Perumal& Sundararajan (2004) Observe the Effect of partial replacement of cement with silica fume on the strength and durability properties of high grade Concrete.Strength and durability properties for M60, M70 and M11 0 grades of HPC trial mixes and to arrive at the maximum levels of replacement of cement with Silica fume, investigations were taken.The strength and durability characteristics of these mixes are compared with the mixes without SF. Compressive strengths of 60 N/mm2, 70 N/mm2 and 110 N/mm2 at 28days were obtained by using 10 percent replacement of cement with SF. The results also show that the SF concretes possess superior durability properties. [2]..

CHARACTERISTICS OF MATERIALS

Cement

Characteristics	Value specified by IS
Specific Gravity	3.16
Consistency (%)	33%
Initial Setting Time	30 (minutes)
Final Setting Time	600 (minutes)

M Sand

Characteristics	Value specified by IS
Bulk density	1.75 Kg/m^3
Fineness modulus	4.66
Specific gravity	2.67

Coarse aggregate

Characteristics	Value specified by IS
Size	20mm
Shape	Angular
Specific Gravity	2.74

MICRO SILICA

PROPERTY	TEST RESULT
SIO_2	85 -97
Specific surface	15000 - 30000
Specific gravity(m^2/kg)	2.22

Micro silica is a Portland cement inchange of fine aggregate replacement it should be finding the increase in strength.

TESTING

COMPRESSIVE STRENGTH FOR COPPER SLAG

Compressive strength after 7 days for cube

S.No	Mix Description	Compressive strength (N/mm^2)	Average Compressive
1	Conventional mix	14.22	16.7
		17.93	
2	10%	16.24	16.93
		17.63	
3	20%	20.56	19.44
		18.32	
4	30%	17.6	18.25
		18.9	

Compressive strength after 28 days for cube

S.No	Mix Description	Compressive strength (N/mm^2)	Average Compressive
1	Conventional mix	25.9	25.65
		25.4	
2	5%	32.4	32.05
		31.9	
3	10%	35.4	35.8
		36.2	
4	15%	29.10	30.7
		32.4	

SPLIT TENSILE STRENGTH FOR MICRO SILICA

Split tensile strength of cylinder for 7 days

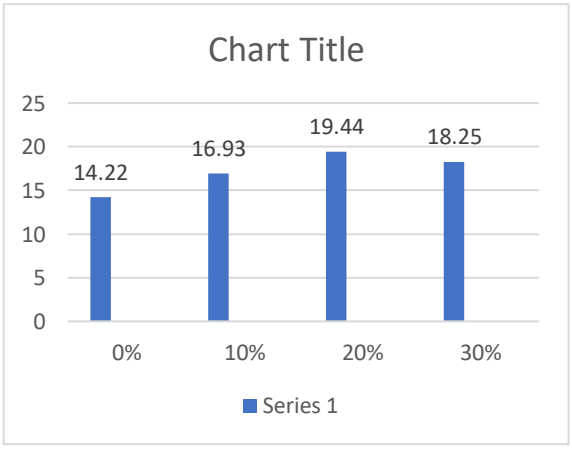
Mix (%)	Split tensile strength (N/mm2) after 7 days		Average compression strength after 7 days
	Specimen1	Specimen2	
0%	2.45	2.75	2.61
15%	2.87	2.95	2.91
20%	2.17	2.13	2.15
35%	1.97	1.95	1.96

Split tensile strength of cylinder for 28 days

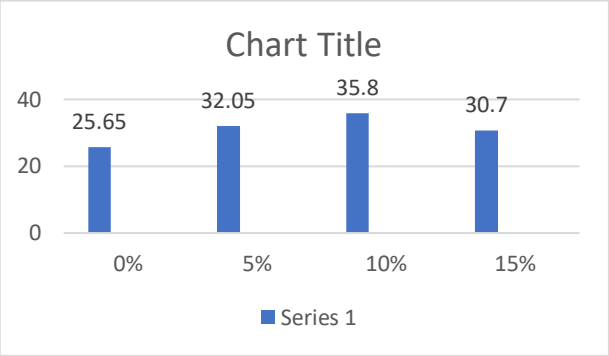
Mix (%)	Split tensile strength (N/mm2) after 7 days		Average compression strength after 7 days
	Specimen1	Specimen2	
0%	3.15	3.19	3.17
15%	3.25	3.58	3.41
20%	3.54	3.98	3.76
35%	3.75	3.34	3.54

RESULT

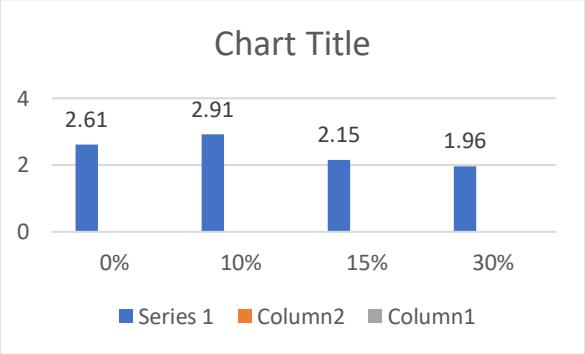
Compressive strength after 7 days for concrete



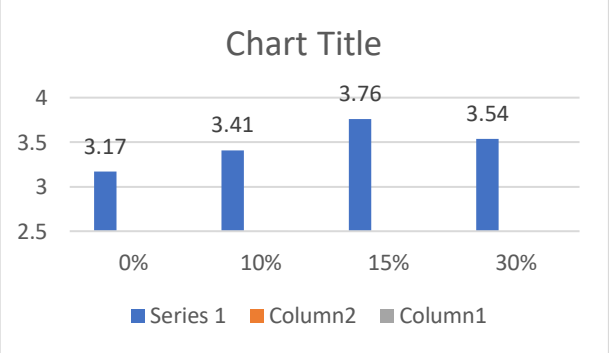
Compressive strength after 28 days for concrete



SPLIT TENSILE STRENGTH FOR MICRO SILICA Split tensile strength of cylinder for 7 days



Split tensile strength of cylinder for 24 days



CONCLUSION

In this project, an experimental study has been conducted on concrete by varying the percentage of copper slag as 0%, 5%, 15% and 20% respectively to study the increase in the compressive strength of concrete.

COMPRESSIVE STRENGTH

After adding 5% silica fume in the mix, there is an increase in thestrength of cube after 7 days.As compared to concrete without replacement after 28 days there is enormous increase in strength as compared to the control mix.By adding 10% micro silica, there is large amount of increase in strength after 7 and 28 days respectively. The Compressive strength tends to increase with increase percentages of silica fume in the mix and decreases after 10% replacement.The optimum strength of cube is gain at 10% replacement for all 7, 14 and 28 days respectively.

SPLIT TENSILE STRENGTH

After adding 5% silica fume in the mix, there is an increase in the strength of cylinder after 7 days as compared to concrete without replacement and after 28 days there is enormous increase in strength as compared to the control mix. The optimum strength of cylinder is gain at 20% replacement for all 7 and 28 days respectively. By adding 10% silica fume, there is large amount of increase in strength after 7 and 28 days respectively. The split tensile strength tends to increase with increase percentages of silica fume in the mix and decreases after 10% replacement.

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