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Effect of Supplementary Cementitious Materials Silica Fumes used as replacement of cement on Split tensile strength and Flexural strength of concrete

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ABSTRACT

The concrete is a major concentration material, having most critical constituent as cement. Cement is the major binding material but the main drawback associated with the use of cement is the landfills and raw material extraction. Moreover, the use of cement is also responsible for the CO2 emission. The Supplementary cementitious material (SCM) have the ability to replace specific amount of cement without affecting the quality of concrete. The waste materials, which canbe used as SCMs like ash, silica oxide fume, ground granulated blast furnace slag, steelslag etc. Micro silica or silica fumes, a very fine non-crystalline material is very good as filler material to provide good strength. In this studya trial has been created to extend the strength of concrete by exchange cement with 0%,5%,10%,15% and 20% of Micro silica fumes in a design mix of M35and M40. The Properties like final Flexural strength, Splitting Tensile strength has been determined for various combine mixtures of materials and these values are compared with the Corresponding values of conventional concrete.

1. Introduction

Supplementary Cementitious Materials consisted of natural, readily accessible abstracts like agitable ash or diatomaceous earth. SCMs such as fly ash, silica fume, arena granulated blast-furnace charcoal etc can be used for not only replacing cement but they may enhance the quality of concrete. The use of SCMs in accurate constructions not alone anticipate these abstracts to analysis the pollution but as well to enhance the backdrop of accurate in beginning and hydrated states.The SCMs can be disconnected into two categories based Hydraulic and Pozzolanic.

- Hydraulic actual reacts anon with baptize to anatomy cementitious compound like GGBS.
- Pozzolanic abstracts do not accept any cementitious acreage but if acclimated with cement or adhesive acknowledge with calcium hydroxide to anatomy products possessing cementitious properties.

1.1 Silica Fume:

It is conjointly a sort of pozolonic material. Silica fume could be a byproduct within the reduction of high-purity quartz with coke in electric discharge furnaces within the production of chemical element and ferrosilicon alloys. Silica fume consists of fine particles with a extent on the order of 215,280 ft²/lb (20,000 m²/kg) once measured by nitrogen sorption techniques, with particles just about one hundredth the dimensions of the common cement due to its extreme fineness and high oxide content, silica fume could be a terribly effective pozzolanic material particle. Silica fume is additional to Portland cement concrete to enhance its properties, particularly, its compressive strength, bond strength, and abrasion resistance. These enhancements stem from each the mechanical enhancements ensuing from the addition of terribly fine powder to the cement paste combine in addition as from the pozzolanic reaction between the silica fume and free caustic lime within the past. Addition of oxide fume conjointly reduces the porosity of concrete to chloride ions, that protects the reinforcing steel of concrete from corrosion, particularly in chloride-rich environments like coastal regions. once silica fume is incorporated, the speed of cement association increases at the first hours thanks to the discharge of OH-ions and alkalis into the thezpore fluid. The raised rate of association is also because of the power of Silicafume to provide nucleating sites to causative association merchandise like lime, zC±S±H, and ettringite. it's been reportable that the pozzolanic reaction of silica fume is extremely significant and therefore the non evaporable water content decreases betweenz90 and 550zdays atlow water /binder ratios with the addition of silica fume. During the last decade, sizeable attention has been given to the utilization of silica fume.

2. Materials and methodology

The detailed of the properties of the materials used, the method followed to design the experiment and the test procedures followed have been explained here.

2. 1 Materials

2.1.1. Cement

The cement used is Ordinary Portland Cement of ACC brand of 43 grade in the present study which surpasses BIS Specifications (IS 8112-1989) on compressive strength levels. The specific gravity was 3.0%, fineness was 2.05%, normal consistency was 34%

2.1.2. Fine Aggregate

Locally obtainable silica sand (IS: 383-1970) has been used. The bulk density of sand is 2640 kg/m^3, specific gravity was 2.57, fineness was 3.08.

2.1.3. Water

Tap water was brought into use for this experiment having specific gravity 1.00.

2.1.3. Superplasticizer: -

In this experiment for improvement of the workability of concrete, super plasticizer- CONPLAST-SP 430 in the form of sulphonated Naphthalene polymers.

2.1.4 Silica Fumes: -

Silica fume used was the by-product of the semiconducting material and ferrosilicon alloy production having spherical particles with a median particle diameter in the range of 120-200 nm. Prepared by reduction of high purity quartz (SiO_2) in electric discharge furnaces at temperatures in more than a 2200°C.

2.2 Pozzolanic effect:

When water is added to OPC (ordinary Portland cement), hydration occur forming two products, as shown below:

OPC + H_2O CSH (Calcium silicate hydrate) + $Ca(OH)_2$

In the presence of micro-silica, the silica oxide from the micro-silica will react with the calcium hydroxide to produce more aggregate binding CSH as follows:

$Ca(OH)_2$+ SiO_2 H_2O+CSH

3. Results and Discussions:

3.1 Splitting Tensile Test:

The tensile strength of the concrete was measured according to IS 456. The applied load was approximately 14-21 kg/cm^2/minute.

SPLIT TENSILE STRENGTH

T = 2P/ pi DL

Where P = applied load

D = diameter of the specimen

L = length of the specimen

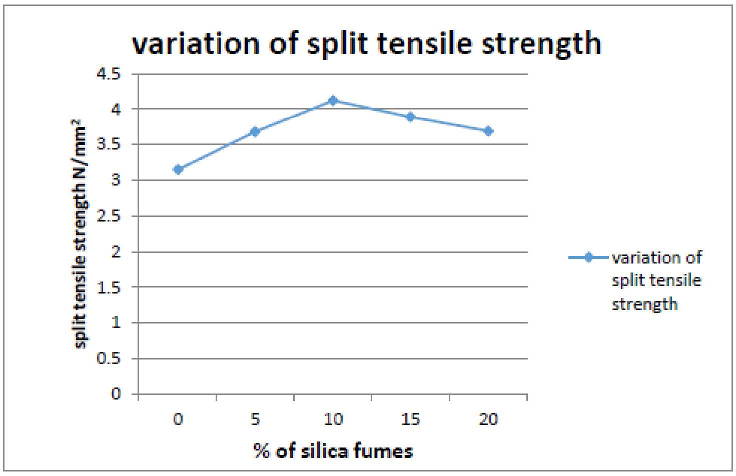

Figure 1: Variation in split tensile strength after 7 days of preparation.

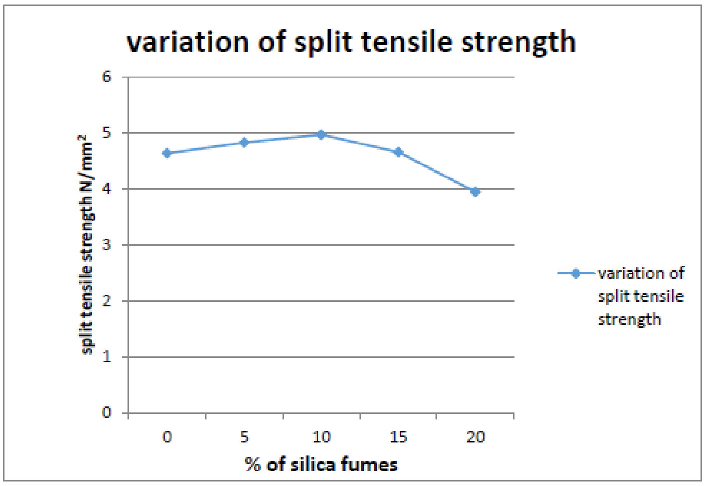

Figure 2: Variation in split tensile strength after 28 days of preparation.

The split tensile strength of the samples was increased as the curing time increased. The maximum tensile strength of the samples was obtained with 10% silica fumes.

3.2 Flexural Strength Test

In order to calculate concrete's flexural strength that comes into play once a road slab with inadequate sub-grade support is subjected to wheel masses and/or there are volume changes thanks to temperature / shrinking. The IS: 516-1959 was used as standard for flexural strength test. Beam mould of size 15 x 15x 70 cm (when size of aggregate is less thanz38 mm). Tamping bar (40 cm long, weighing 2 kg and tamping section having size of 25mm x 25 mm)

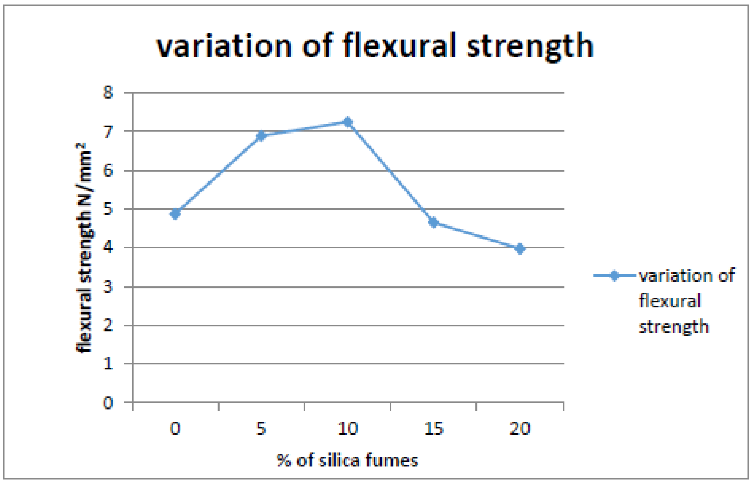

Figure 3: Variation in flexural strength after 7 days of preparation.

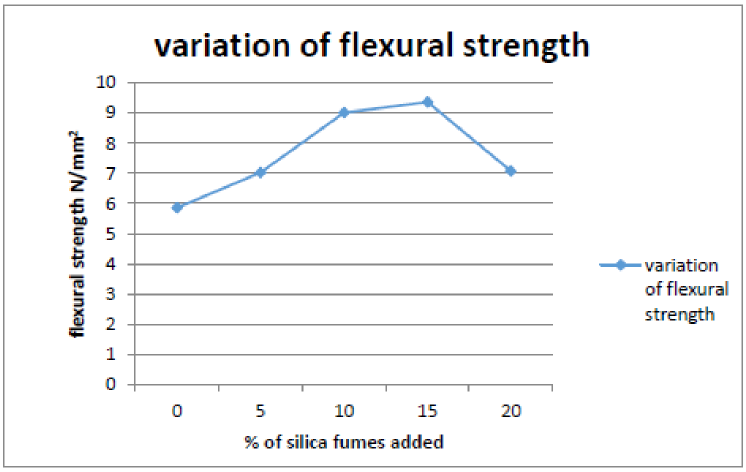

Figure 4: Variation in flexural strength after 28 days of preparation.

The flexural strength of the samples was increased as the curing time increased. The maximum tensile strength of the samples was obtained with 15% silica fumes.

4. Conclusions

Silica fumes were mixed properly to form the concrete specimen for investigation.

Inclusion of silica fumes enhanced the tensile strength of the concrete. Inclusion of 10% silica fumes showed maximum compressive strength.

The silica fumes inclusion increased the flexural strength of the concrete and the loss in compressive strength and weight loss was less in case of silica fumes. The inclusion of 15% silica fumes showed maximum flexural strength.

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