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Effect on Mechanical Properties of Fibre Reinforced Concrete by Partial Replacement of Cement with Silica Fume

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***Abstract* - The experiment work carried out by silica fume as a supplementary material for cement and evaluates cement for M20, M25 and M30 grades of concrete. We are adding 0%, 5%, 10% and 15%, by weight of cement in concrete and also added glass fiber. At 1% addition of glass fiber, 10% silica fume with water cement ratio 0.55,0.5 and 0.45 the compressive strength and at 1% glass fibers at 10% silica fume tensile strength gives best result in concrete.**

Silica fume is also known as the micro silica contributes to workability and strength by creating dense packing and pore filter of cement paste. Whereas glass fibers is a material consisting numerous extremely small fibers of glass which reacts insulation to reinforced concrete and gives tremendous tensile and compressive strength.

The experimental work carried out by silica fume as a supplementary material for cement and evaluates cement for M20, M25 & M30 grades of concrete. We are adding 0%, 5%, 10% and 15% of silica fume by weight of cement and adding 0%, 1%, 2% and 3% of glass fibers by the weight of concrete

1.INTRODUCTION

Concrete is a composite material composed of mainly of water, aggregate, and cement. Often, additives and reinforcement are included in the mixture to achieve the desired physical properties of the finished material. When these ingredients are mixed together, they form a fluid mass that is mould into shape. Over time, cement forms a hard matrix which binds the rest of ingredients together into a durable stone like material with many uses famous concrete structures include the Hoover Dam, the Panama Canal and the Roman Pantheon. The earliest large-scale users of concrete technology were the ancient Romans, and concrete was widely used in the Romans Empire. The Coliseum in Rome was built largely of concrete, and the concrete dome of the pantheon is the world largest unreinforced concrete dome. After the Roman Empire collapsed, use of concrete became rare until the technology was re-pioneered in the mid-18th century. Today concrete is the most widely used man-made material.

1.1 PRINCIPLE OF SILICA FUME

Silica Fume, Also Known as microsilica, (CAS number 69012-64-2, EINECS number 273-761-1) is an amorphous (non-Crystalline) polymorph of silicon dioxide, silica. It is an ultrafine powder collected as a by-product of the silicon and ferrosilicon alloy production and consists of spherical particles with an average particle diameter of 150 nm. The main field of application is as pozzolanic material for high performance concrete.

1.2 OBJECTIVES

1. Micro silica is initially produced as an ultra-fine dandified powder.
2. At least 98% SIO2 content.
3. Mean particle size between 0.1 and 0.2 micron.
4. Minimum specific surface area is 15,000 m2/kg.
5. Spherical particle shape

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 and 28 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.

- 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 M110 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/mm and 110N/mm2at 28days were obtained by using 10 percent replacement of cement with SF. The results also show that the SF concretes possess superior durability properties.

3. MATERIALS AND PROPERTIES

This chapter briefly describes the final results of the properties of all materials used in this project. The IS codes (Indian Standard) important practice considered for all tests in the reference and all test on materials were performed by the code system is pertinent and rules.

3.1 CEMENT

As the plastic optical fiber is in charge of the transmission of light, there is no unique bond required. So conventional Portland bond is utilized for Silica Fume.

3.2 FINE AGGREGATE

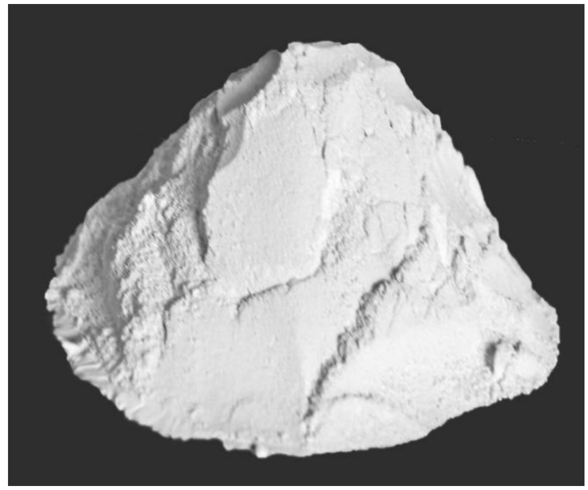
The fine aggregate used was obtained from a nearby river source. The fine aggregate conforming to zone II according to IS: 383-1970 was used.

3.3. COARSE AGGREGATES

Crushed granite was used as coarse aggregate. The coarse aggregate according to IS:383-1970 was used. Maximum coarse aggregate size used is 20 mm.

3.4. SILICA FUME

Silica fume is an ultrafine material with spherical particles less than 1 μm in diameter, the average being about 0.15 μm. This makes it approximately 100 times smaller than the average cement particle.[4]. The bulk density of silica fume depends on the degree of densification in the silo and varies from 130 (undensified) to 600 kg/m3. The specific gravity of silica fume is generally in the range of 2.2 to 2.3. The specific surface area of silica fume can be measured with the BET method or nitrogen adsorption method. It typically ranges from 15,000 to 30,000 m2/kg



3.5. GLASS FIBER

Glass fibers are formed from melts and manufactured in various compositions by changing the amount of raw materials like sand for silica, clay for alumina, calcite for calcium oxide, and colemanite for boron oxide. Therefore, different types of glass fibers show different performances like alkali resistance or high mechanical properties using various amounts of silica or other sources. Glass fiber products are classified according to the type of composite at which they are utilized. Moreover, chopped strands, direct draw rovings, assembled rovings, and mats are the most important products that are used in the injection molding, filament winding, pultrusion, sheet molding, and hand layup processes to form glass fiber-reinforced composites. Protection of the glass fiber filaments from breakage or disintegration is an important issue either during manufacturing of glass fiber or during composite production. Applying sizing agent to the glass fiber during manufacturing of fibers causes lubrication of the glass fiber filaments in addition to inhibit static electricity accumulation, adhesion of the fiber filaments together, and adhesion between fiber filaments and polymer matrix of the composites. During manufacturing of composites, an interphase layer, at which interpenetration of the sizing to the matrix or diffusion of the matrix polymer to the sizing, is formed. The resultant interphase layer can either increase or decrease the performance of the composite considering harmony between sizing components and matrix polymer.

3.6 WATER

Water is a key ingredient, clean potable water used from the tap in concrete lab. This water was used in making fine concrete specimens.

Water was free from suspended solids and natural materials, which could have influenced the properties of later and solidified fine concrete. The PH estimation of the water was 7.0

4. MIX COMPOSITION AND SPECIMEN PREPARATION

In this experiment has four blocks casted each one has in different properties as below as

1. First block is 100% of cement, sand.
2. 95% cement, 5% Silica Fume, Glassfiber
3. 90 % cement ,10 % Silica Fume, Glass fiber.
4. 85% cement ,15% Silica Fume, Glass fibers.

MIX DESIGHN	SILICAFUME	GLASS FIBERS	CEMENT
M0	0%	0%	100%
M1	5%	1%	95%
M2	5%	2%	95%
M3	5%	3%	95%
M4	10%	1%	90%
M5	10%	2%	90%
M6	10%	3%	90%
M7	15%	1%	85%
M8	15%	2%	85%
M9	15%	3%	85%

Before filling these cubes with cement mix they were coated with oil, with the goal that the fine solid 3D shapes would not hold fast to the molds. The threw shape was kept undisturbed on the leveled plat structure. At that point it was de-formed cautiously following 24 hours from throwing. Following de-formed the block examples were set apart by their separate distinguishing proof of imprints/numbers. Cut the extra – long strands same as thickness of form. Clean the squares surface by utilizing cleaning paper or utilizing sandpaper

5. EXPERIEMENTAL PROGRAM

We have maintained the various types of mix designation casting moulds calculated the compressive test, light transmittance test and durability tests. compressive test is a simple test to perform and somewhat in light of the fact that the qualities properties of fine cement is alluringly identified with its compressive quality. the test is done on examples like 3D cubes. In this test we are casted by Five cubes of size 15 cm x15 cm x 15 cm. one cube was of regular fine concrete has 100 % cement, sand. Another cube of 100% cement, sand, fibers and also third cube was 95% cement, 5 % Silica fume, Glass fibers one more cube was 90% cement, 10% Silica fume Glass fibers. Fifth cube was made up of 85% cement, 15% Silica Fume, Glass fibers. The optical fibers in compressive fine concrete were distributed in horizontal direction. Before filling these cubes with cement mix they were coated with oil, so that the fine concrete cubes would not adhere to the moulds. The compressive strength of these cubes was found out using compressive testing machine (CTM)

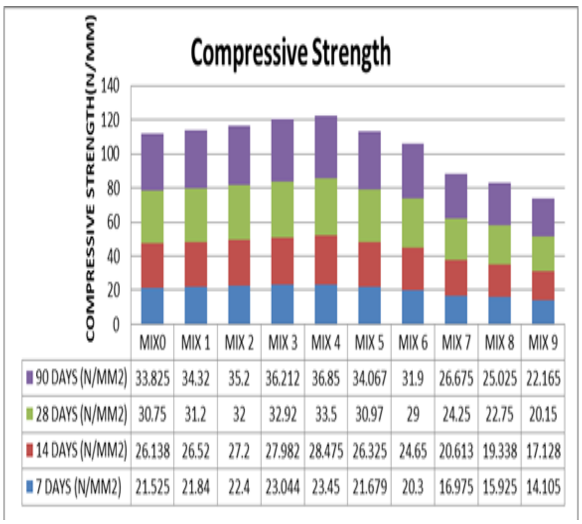
Figure: Compression Test Machine

6. RESULTS AND DISCUSSIONS

6.1 COMPRESSIVE TEST

The compressive quality is estimated on the cubic 15x15x15 cm examples as per the Indian standard Tests were tried for the compressive quality at 7, 14, 28 & 90 days of age.

MIX DESIGHN	SILICAFUME	GLASS FIBERS	CEMENT
M0	0%	0%	100%
M1	5%	1%	95%
M2	5%	2%	95%
M3	5%	3%	95%
M4	10%	1%	90%
M5	10%	2%	90%
M6	10%	3%	90%
M7	15%	1%	85%
M8	15%	2%	85%
M9	15%	3%	85%

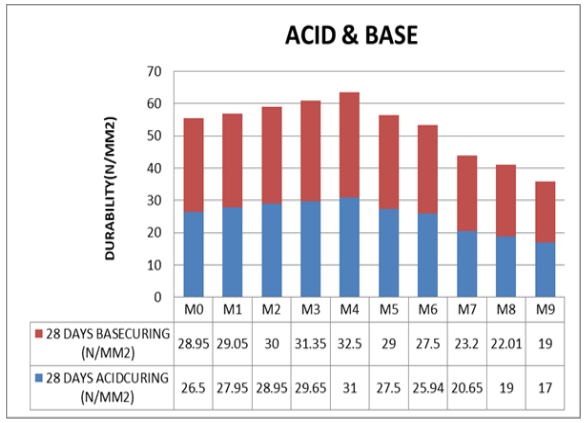


Mix proportion

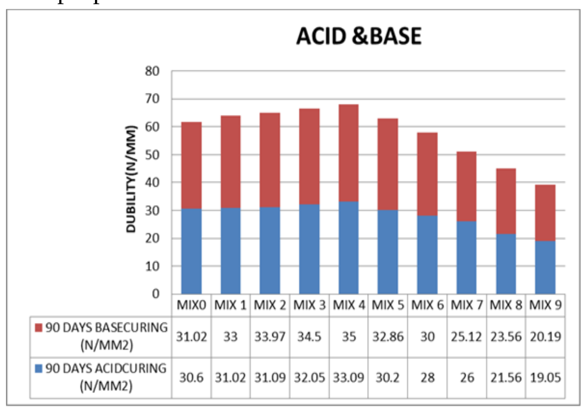
We have observed the mix proportion s, we got maximum compressive strength at M0 i.e. M4 Normal mortar

6.2 DURABILITY TEST

To check durability of cement mortar mix, Cubes of size 15cmX15cmX15cm was casted using different mix proportion. Next After 24 hours the specimens will remove from the mould and subjected to water curing for 28 days. The specimens were taken out from the curing tank and initial weight was taken. After this step, cubes were immersed in salt water for 28 & 90 days and again weighted and then weight in loss was calculated.

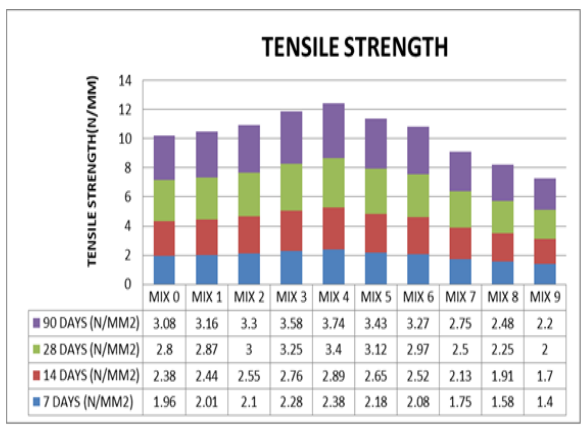


Mix proportion



Mix proportion

6.3 TENSILE STRENGTH TEST FOR CEMENT MORTAR



7.CONCLUSION

1. The compressive and Tensile strength of concrete are increased by replacing cement with silica fume and addition of glass fibres as compared to conventional concrete

2. The optimum value of compressive strength can be achieved in 10% replacement of silica fume and 1% addition of glass fibres and at a large dosage of silica fume and glass fibres the average compressive strength of concrete is decreased beyond 10% silica fume and beyond 1% glass fibres
3. The optimum value of tensile strength can be achieved in 10% replacement of silica fume and 2% addition of glass fibres and at a large dosage of silica fume the average tensile strength of concrete is decreased beyond 10% and beyond 2% glass fibres
4. This type of concrete can be used in the cement concrete pavements because silica fume can reduce setting time of concrete and increase the strength
5. At 10% silica fume and 1% glass fibres the compressive strength increased by 13.68% than conventional concrete
6. At 10% silica fume and 2% glass fibres the tensile strength increased by 36.8% than conventional concrete

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