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1. A process for the preparation of high strength concrete using glass fibers.
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3. A process for the preparation of high strength concrete using glass fibers, in which the said glass fibers are of short length, 12 mm in length, 14 microns in diameter and also alkali resistant glass fibers.
4. A process for the preparation of high strength concrete using glass fibers, in which the said glass fibers were, imparted alkali nature by incorporating zirconium to the tune of not more than 16 wt% into the glass fibers.
5. A process for the preparation of high strength concrete, as claimed in claims 1 to 3, using glass fibers that provide reinforcement to the concrete in all three directions, because of their orientations in all possible directions.
6. The glass fibers reinforced concrete (GFRC), the product which resulted from the process as claimed in the above four claims also provides crack resistance to the concrete.
7. The product of the above claimed process, that is GFRC is possessing glass fibers, of properties as mentioned in the above claims, to the tune of 600 gm/m^3 or 800 gm/m^3 and both the concrete composites exhibit rise in compressive strength, in comparison to the composites without glass fibers.

Trustee
Parul Arogya Seva Mandal

23-10-2013.

The following specification particularly describes and ascertains the nature of the invention and the manner in which it is performed.

Indian Patent Application

Complete Specification

TITLE: Process for Preparation of High Strength Concrete Using Glass Fibers

ABSTRACT

Glass-fiber reinforced concrete (GFRC) is a material made of a cementitious matrix composed of cement, sand, water and admixtures, in which short length glass fibers are dispersed. In this study trial tests for concrete without and with alkali-resistant (AR) glass fibers are conducted to indicate the differences in compressive strength by using specimens of standard size cubes.

GFRC is a form of concrete that uses fine sand, cement, AR-glass fiber, water, and other admixtures. It is mainly used in exterior building façade panels and as architectural precast concrete. This material is ideally suitable in making shapes on the front of any building and it is less dense than steel.

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Field of the invention

Concrete is the most widely used construction material possessing several desirable properties like high compressive strength, stiffness and durability under usual environmental factors. But, at the same time, concrete is brittle and weak in tension. Plain concrete has two deficiencies, low tensile strength and a low strain at fracture. These shortcomings are generally overcome by reinforcing the concrete. Normally reinforcement consists of continuous deformed steel bars or pre-stressing tendons. The advantage of reinforcing and pre-stressing technology utilizing steel reinforcement as high tensile steel wires have helped in overcoming the incapacity of concrete in tension.

This innovation deals with the study of compressive strength, split tensile strength and flexural strength of concrete incorporated with glass fibers in different proportions viz., 0.6, 0.8 and 1.0 kg per m^3. The compressive strength of concrete (Grade M50) specimens was checked by making concrete cubes, beams and cylinders of standard size cured for 7 to 28 days.

The first generation of glass fibers was identified as E-glass fibers, and they were not chemically stable in conventional cement concrete. Specifically, the alkalis in the cement attack the E-glass and within a very short period of time the fibers break down. Then AR-glass or alkali-resistant glass fibers, which were coated with zirconium to protect the glass from alkali attack, were introduced. These fibers worked, but they did not have long-term chemical stability. The need for stability spawned the current generation of AR-glass fibers where the zirconium is integrated into the fiber: Up to 16% of the weight of the current AR-glass fiber is zirconium. The long-term chemical stability of AR-glass fibers has been proven.in research and technical data.

Background of Invention:

The present day world is witnessing the construction of very challenging and difficult civil engineering structures. Quite often, concrete being the most important and widely used material is called upon to possess very high strength and sufficient workability properties. Efforts are being made in the field of concrete technology to develop such concretes with special characteristics.

Researchers all over the world are attempting to develop high performance concretes by using fibers and other admixtures in concrete up to certain proportions. In the view of the global sustainable developments. it is imperative that fibers like glass. carbon. polypropylene and aramid fibers provide improvements in tensile strength. fatigue characteristics. durability. shrinkage characteristics, impact, cavitation. erosion resistance and serviceability of concrete. Fibers impart energy absorption. toughness and impact resistance properties to fiber reinforced concrete material and these characteristics in turn improve the fracture and fatigue properties.

Research in glass fiber reinforced concrete resulted in the development of an alkali resistant fibers high dispersion that improved long term durability. This system was named 'alkali resistance glass fiber reinforced concrete'. In the present experimental investigation the alkali resistance glass fibers have been used to study the effect on compressive, split tensile and flexural strength on M20. M30. M40 and M50 grades of concrete.

Detailed Description of the Invention

- The mixture proportion was done as per IS 10262-2009. The target mean strength was 58.5N/mm^2. The Ambuja cement (PPC-53) was used. The total binder content was 450 kg/m^3. fine aggregate is taken 720 kg/m^3 and coarse aggregate is taken 1130 kg/m^3 the water to binder ratio was kept constant as 0.35. the Super plasticizer content was varied to maintain a slump of 70-90 mm for all mixtures i.e for 740 kg it is 20 mm and for 398 kg it is 10 mm. Total proportion was C : F.A : C.A : W -- 1 : 1.6 : 2.51 : 0.35 and admixture was added 1.2 % of cement content.
- Water absorption capacity and moisture content were taken into consideration and appropriately subtracted from the water/cement ratio used for mixing.
- The glass fiber was used at a dose of 600 gm/m^3 for casting cubes.
- The size of cubes was 150mmX150mmX150mm. for the compressive strength test.
- Compaction of concrete in three layers with 25 strokes of 16 mm rod was carried out for each layer. The concrete was left in the mould and allowed to set for 24 hours before the cubes were de moulded and placed in curing tank.
- The concrete cubes were cured in the tank for 7. 28 days.

Calculation for Mix Design:

Glass Fiber

The fiber which is used in this experiment is AR-GLASS fiber or ALKALY RESISTENT glass fiber.

Table-1

Fiber	Density t/m^3	Tensile strength IN(M.pa)	No. of fibers (million /kg)
AR	2.6	1700	220

The density of AR Glass fiber is similar to that of concrete and this coupled with an excellent aspect ratio (857:1) aids in achieving very high dispersion. Cem-FIL Anti-Crack HD fibers have a higher Elastic Modulus (2-3 times) than that of concrete, and therefore do still provide an extra reinforcement against cracking. Polypropylene or Polyester fibers no-longer act as a reinforcement to prevent cracking, during this stage as their elastic modulus is less than that of even concrete.

Experimental Program

(a) Cement

Cement which is used in the experiment is PPC cement of AMBUJA which helps in making the mix design of M-50. The specific gravity of cement is 3.15 and the initial setting time was 45 min and final setting time 450 min.

(b) Aggregate

1. Fine Aggregate (Sand):

Sand was used in experiment in two types. zone III and zone I by mixing both cement we get the zone II sand the average fineness modulus of sand was 3.09 so it was medium as per IS. Moisture content of the sand is 4.10. So it will reduce the water content.

Table- 2

Description	Results
Fineness Modules	3.09
Zone	II
Water Absorption	3.85
Specific Gravity	2.67

2. Coarse Aggregate:

Table- 3

TEST	RESULT	
	10 mm	20 mm
Water absorption (%)	2.1	2.18
Specific gravity	2.74	2.78
Impact value	9.70	10.01
Crushing value	14.15	15.10

Result of Gradation of Aggregate

3. Glass Fiber

Then AR-glass or alkali-resistant glass fibers. which were coated with zirconia to protect the glass from alkali attack. were introduced. These fibers worked. but they did not have long-term chemical stability. The need for stability spawned the current generation of AR-glass fibers where the zirconia is integrated into the fiber: Up to 16% of the weight of the current AR-glass fiber is zirconium. The glass fiber is of five types' e-glass. s-glass. c-glass. AR-GLASS. The glass fiber use shall be high-quality Alkaline–Resistant glass fiber which is designed to reinforce cementations and other alkaline materials.

12 mm length

14 micron diameter

600 gm/m^3. 800 gm/m^3, 1000 gm/m^3

White color

Cem-FILL Anti crack HD

GFRC Properties

The GFRC shall be of the following properties on completion of cure. the dry density of the GFRC

Should not be less than 1700 kg/m^3

Compressive Strength tested to ASTM: C 109/C 109M: 2002

A) Maximum Load: - 53269.7 N

B) Compressive Strength: - 21.31 N/mm^2

Flexural Strength tested to ASTM: C 580 – 98

A) Flexural Strength: - 33.8 N/mm^2

B) Modulus of Elasticity: - 6172.8 MPa

Charpy Impact Strength: - 12.0 KJ/m²

(Tested to ASTM D6110: 1997)

Coefficient of Thermal Expansion 10.5 µm / m°C

(Tested to ASTM E831: 2000)

Thermal Conductivity 0.12258 w / m K

(C) Super-Plasticizer

The admixture for the get the workability of M-50 concrete here I used the admixture of Cumacon 3755ss (4.5 kg/m^3).it is used for increase the workability in small water cement ratio.

(D) Water

Water was used in the mix the drinkable water pH 7.9

Test Methods

The test is carried out on cube specimens of dimensions: (150x150x150mm). Cast-iron moulds are used to cast the cubes having leak proof metal base plate. The joints between the sections of moulds are thinly coated with the mould oil to prevent adhesion of concrete to the mould surface. All materials should be thoroughly mixed. for (2-3) minutes. before adding the glass fibers. After mixing glass fiber. for 1 minute. the cubes are casted.

Curing

After molding, the specimens are stored on the site free from vibration under damp matting. sack or other similar material for 24 hours from the time of addition of water to the other ingredients. After a period of 24 hours cubes were marked. After removing from the moulds. cubes were stored in clean potable water at a temperature of 24^0 C to 30^0 C until they were transported to the testing laboratory.

Result

Grade of Concrete	No of days	Compressive Strength (N/mm^2)		
		Without GFRC	With GFRC	% of fiber
M 50	7	34.58	35.12	600 gm/m^3
	28	51.58	53.12	
	7	34.58	36.48	800 gm/m^3
	28	51.58	48.45	

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