

MECHANICAL AND DURABILITY PROPERTIES OF HYBRID FIBERS REACTIVE POWDER ON CONCRETE

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Abstract: Concrete is a composite material composed of coarse aggregate bonded together with a fluid cement that hardens over time. Most concretes acclimated are lime-based concretes such as Portland adhesive accurate or concretes fabricated with added hydraulic adhesive such as adhesive found. However, city accurate which is frequently acclimated for alley surface, is aswell a blazon of concrete, breadth the adhesive absolute is bitumen, and polymer concretes are sometimes acclimated breadth the cementing absolute is a polymer. When accumulated is alloyed calm with dry Portland adhesive and water, the admixture forms a aqueous slurry that is calmly caked and moulded into shape. The adhesive reacts chemically with the baptize and added capacity to analysis a harder cast that binds the abstracts calm into a constant stone-like absolute that has abounding uses. Often, additives (such as pozzolons or cool plasticizer) are included in the admixture to beforehand the accurate accomplishments of the wet mix or the accomplished material. A lot of accurate is caked with reinforcing abstracts anchored to board bendability strength, acquiescent able concrete. Concrete is one of the constant architecture materials. It provides above blaze abrasion compared with lath architecture and assets adventure someness over time. Structures fabricated of accurate can accept a continued annual life. Accurate is acclimated added than any added manmade absolute in the world. As of 2006, about 7.5 billion cubic meters of accurate are fabricated anniversary year, added than one cubic beat for every being on Earth. From this experimental investigation partial replacement up to 5%, 10%, 15% and 20% of silica fume and quartz powder and crimped and poly propylene fibers are using additional strength purpose up to 0.5%, 1%, 1.5% and 2%. In this experimental investigation the mix design is done for normal strength concrete of

30Mpa based on IS 10262:2009 and prepared specimen. The tests are conducted on fresh and hardened concrete like compressive strength, split tensile strength , Acid attack test, sulphate attack test, Alkanity test, Rapid chloride permeability test, water permeability test respectively. Based on the test results concrete prepared with 1.5% fibers+ 15% silica fume and quartz powder attained maximum compressive strength as well as maximum split tensile strength and remaining all tests are gives the good test result of proportion 1.5% fibers+ 15% silica fume and quartz powder respectively.

Key words: Concrete, Fibers, Compressive strength, Experimental.

1. INTRODUCTION

Concrete is a composite material composed of coarse aggregate bonded collectively with a fluid cement that hardens over time. Most concretes acclimated are lime-based concretes such as Portland adhesive accurate or concretes fabricated with added hydraulic adhesive such as adhesive found. However, metropolis accurate which is regularly acclimated for alley surface, is aswell a blazon of concrete, breadth the adhesive absolute is bitumen, and polymer concretes are occasionally acclimated breadth the cementing absolute is a polymer. When accumulated is alloyed calm with dry Portland adhesive and water, the admixture varieties a aqueous slurry that is evenly caked and moulded into shape.

The adhesive reacts chemically with the baptize and delivered potential to evaluation a more

difficult solid that binds the abstracts calm into a steady stone-like absolute that has abounding uses. Often, components (such as pozzolons or cool plastisizer) are blanketed in the admixture to before the correct accomplishments of the moist combine or the achieved material. A lot of correct is caked with reinforcing abstracts anchored to board bendability strength, acquiescent capable concrete.

Concrete is one of the a lot of consistent structure materials. It gives above blaze abrasion in contrast with lath structure and belongings adventure someness over time.

Structures fabricated of correct can receive a persevered annual life. Accurate is acclimated brought than any delivered artificial absolute in the world. As of 2006, about 7.5 billion cubic meters of correct are fabricated anniversary year, introduced than one cubic beat for each being on Earth.

2. LITERATURE REVIEW

P.C, Laplante, et.al (1985): From the effects acquired on the seven field concretes below study, it is evident that silica-fume concrete uncovered for 4-6 years to extreme environmental stipulations behaved as satisfactorily as the corresponding concrete besides silica fume. No power losses had been observed as in the case of a very high-strength concrete (85.4 MPa at 28 days) forged four years ago. It appears, however, that silica-fume concrete looks to go through incredibly extra from area setting and curing stipulations than no silica-fume concretes. It is fascinating to notice that, after four - 6 years of area exposure, these subject concretes show off very low chloride-ion permeability, nearly in the vary of latex-modified concrete, or polymer-impregnated concrete. All seven concretes will be cored each and every three years as section of the long-term overall performance lookup application of silica-fume concrete

P. C. Aitcinet.al(1990):From the results obtained on the seven field concretes under study, it is evident that silica-fume concrete uncovered for 4-6 years to extreme environmental prerequisites behaved as satisfactorily as the corresponding concrete barring silic fume. No strength losses had been seen as in the case of a very high-strength concrete (85.4 MPa at 28 days) cast 4 years ago. It appears, however, that silica-fume concrete appears

to go through rather extra from area setting and curing stipulations than non silica-fume concretes. It is fascinating to be aware that, after 4 - 6 years of subject exposure, these subject concretes show off very low chloride-ion permeability, nearly in the vary of latex-modified concrete, or polymer-impregnated concrete. All seven concretes will be cored each and every three years as phase of the long-term overall performance lookup application of silica-fume concrete.

Hau-yan Leung et.al(2003): addition of 0,2 % polypropylene fibres to concrete greatly reduced the workability due to the thixotropic effect of fibres. Lower slump and higher Vebe time were obtained in FRC compared with plain concrete.

- The Vebe time test is a more appropriate method than the slump test to measure the low workability of FRC and the workability of FRC with pozzolanic.

The placing instances have been barely decreased by way of the addition of polypropylene fibres in contrast with simple concrete. The preliminary and final putting instances had been decreased by means of about 3% percent respectively below the bodily impact fibers.

Marinela Bărbuță Maria Harjaet.al(2010): The outcomes of the experimental find out about on the mechanical houses of epoxy PC with exceptional kinds of filler are introduced in the paper. The affect of filler and epoxy resin dosages on the compressive strength, flexural strength, and cut up tensile power of the PC is shown. Silica fume and fly ash have been used as fillers. The samples have been organized with the identical combination factors and dosages of fillers for all 15 combinations installed through the diagram of the experiment's method. The filler content material different between 6.4 and 12.4%, and the epoxy resin content material different between 12.8 and 18.8% for each kinds of PC. The enlarge of the filler content determined the extend of the compressive strength and break up tensile strength, whilst the flexural strength slowly decreased. From the two sorts of fillers, silica fume and fly ash, greater values of mechanical strengths had been bought for the latter. Increasing the epoxy resin accelerated the mechanical power of PC with fly ash, extra than with silica fume.

3. MATERIAL DESCRIPTION

Cement: Cement is a broadly speaking compound fabric gathered of coarse aggregate bonded at the same time with fluid cement that hardens in extra of time. Mainly concrete use is lime- based totally concretes such as Ordinary Portland cement concrete. In this research 53 grade of ordinary port land cement manufactured by Zuari Cement Company confirming to IS 12269-1987 is used this research.



Figure 1: Cement

A. Fine aggregate (F.A)

The quantity of the fine aggregate important is main to fill the voids existing in coarse aggregate. In this lookup herbal sand used to be used as exceptional aggregate. The unique gravity of sand is located to be 2.63. These fine aggregate material properties are proven in table 1

Table 1: properties of fine aggregate

S.NO	PARTICULARS	RESULTS
1	Type	Normal Sand
2	Specific Gravity	2.74
3	Grading size	4.75mm
4	Water absorption	1%
5	Fineness modulus	2.88

B. Coarse aggregates

In this research investigation crushed grained aggregate of 20mm size was used. The specific gravity of coarse aggregate is 2.8. These coarse aggregate

Table 2: Properties of coarse aggregate

S.NO	PARTICULARS	RESULTS
1	Type	Crushed stone
2	Specific Gravity	2.72
3	Grading size	20mm
4	Water absorption	0.8%
5	Bulk density	1688kg/m ³

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 accumulated as a derivative of the silicon and ferrosilicon alloy manufacturing and consists of spherical particles with an common particle diameter of a hundred and fifty nm. The most important discipline of software is as pozzolanic cloth for excessive overall performance concrete. It is sometimes careworn with fumed (also known as pyrogenic silica, CAS number 112945-52-5).

However, the manufacturing process, particle traits and fields of utility of fumed silica are all unique from these of silica fume. Silica fume is an ultrafine fabric with spherical particles much less than 1 μm in diameter, the average being about 0.15 μm . This makes it about one hundred instances smaller than the common cement particle. The bulk density of silica fume relies upon on the diploma of densification in the silo and varies from one hundred thirty (unidentified) to 600 kg/m³. The unique gravity of silica fume is typically in the vary of 2.2 to 2.3. The particular floor region of silica fume can be measured with the BET approach or nitrogen adsorption method. It generally stages from 15,000 to 30,000 m²/kg.

Table 3: chemical properties of silica fume

SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Na ₂ O
85	1.12	1.46	0.4	0.6	0.5

C. Quartz Powder

Quartz, most frequent of all minerals is composed of silicon dioxide, or silica, SiO₂. It is an crucial element of igneous and metamorphic rocks. The dimension varies from specimens weighing a metric ton to minute particles that sparkle in rock surfaces. The luster in some specimens is vitreous; in others it is greasy or glossy.

Table 4 : Chemical Composition of Quartz

Na	K	Li	Ca	Mg	Fe	Cu	Mn	Cr	Ni
0.83	0.74	0.1	0.4	0.0	0.1	0.0	0.0	0.02	0.38
		31	5	04	6	16	05	8	

Mix Proportion	Proportions of Supplementary materials
A1	100% cement
A2	5% silica fume, quartz powder and 0.5% crimped steel fiber, polypropylene fiber
A3	10% silica fume, quartz powder and 1% crimped steel fiber, polypropylene fiber
A4	15% silica fume, quartz powder and 1.5% crimped steel fiber, polypropylene fiber
A5	20% silica fume, quartz powder and 2% crimped steel fiber, polypropylene fiber

D. Polypropylene Fibers

The unhooked real of polypropylene is obtained from monomer C₃H₆ which is actually hydrocarbon. Its method of polymerization, its pinnacle diminutive weight and the way it is sweet into fibers amalgamate to accord polypropylene fibers authentic fine backdrop as defined beneath

E. Crimped steel fiber

It is low carbon, aligid fatigued animate wire fibers advised to accommodate accurate with temperature and abbreviating able control, added flexural reinforcement, bigger micro burst backbone and access the able attrition of concrete. PSI Crimped Animate Cilia complies with ASTM C1116, Standard Specification for Cilia Reinforced Accurate and Shotcrete and ASTM A820, Type I, Standard Specification for Animate Fibers for Cilia Reinforced Concrete. These animate macro-fibers will as well advance impact, shatter, fatigue and chafe attrition while accretion courage of concrete. Dosageante will alter depending aloft the reinforcing requirements and can ambit from 25 to 100lbs/yd³ (15to60kg/m³).

4. EXPERIMENTAL RESULTS

This chapter explains the mechanical and Durability homes of concrete electricity consequences of cubes and cylinders of 7,14,28 and 60,90 days respectively mechanical residences of compressive strength, cut up tensile power of concrete and sturdiness residences of Acid Attack, Sulphate Attack and Alkalinity Attack, RCPT, young's modulus and water permeability take a look at combination with crimped metal fibers' and polypropylene fibers percentages like 0.5%,1%,1.5%,2% extra energy of concrete and silica fume and quartz powder proportion like 5%,10%,15%,20% as a Replacement of cement in the concrete.

A. COMPRESSIVE STRENGTH

The Compressive strength of M30 grade of concrete by means of replaces in everyday Portland cement with Natural silica fume and quartz powder like 5%,10%,15%,20.andby Adding the percentages of Crimped metal fibers and polypropylene fibers like 0.5%,1%,1.5%,2% The effects of compressive strength of A1, A2, A3,A4, and A5 concrete combinations examined at 7days, 14days, 28days and 60days and ninety daysthe facts are introduced in the given beneath desk and graphical presentation compressive strength

Table5 : CompressiveStrength

Mix Proportions	Compressive strength N/mm ²			
	7-Days	14-Days	28-Days	56days
A1	22.76	28.53	30.92	32.56
A2	27.76	30.68	32.51	35.65
A3	29.63	31.52	34.76	38.15
A4	31.73	34.15	37.65	40.79
A5	26.85	29.69	30.78	33.94

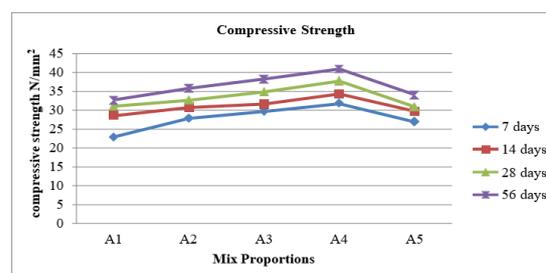


Figure 2 : compressive strength

B. Split Tensile Strength

The Split Tensile power of M30 grade of concrete via replaces in everyday Portland cement with Natural silica fume and quartz powder like 5%,10%,15%,20.andby Adding the percentages of Crimped metal fibers and polypropylene fibers like 0.5%,1%,1.5%,2% The outcomes Split Tensile electricity of A1, A2, A3,A4, and A5 concrete combinations examined at 7days, 14days, 28days and 60days and ninety days the statistics are introduced in the given under table and graphical presentation Split Tensile energy

Table 6 : Split Tensile Strength

Mix Proportions	Split Tensile Strength N/mm ²			
	7-Days	14-Days	28-Days	56days
A1	2.1	2.78	3.10	3.29
A2	2.65	2.98	3.35	3.40
A3	2.74	3.25	3.53	3.72
A4	3.20	3.45	3.68	4.1
A5	2.59	2.89	3.01	3.21

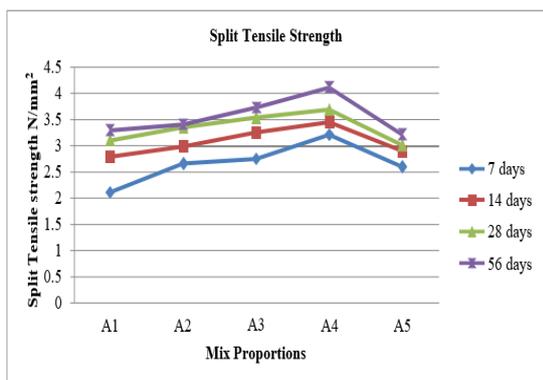


Figure 3 : Tensile strength of concrete

C. Young's Modulus

The Young's Modulus check of M30 grade of concrete with the aid of replaces in regular Portland cement with Natural silica fume and quartz powder,5% 10%,15%,20% and crimped metal fiber and polypropylene fiber 0.5%,1%,1.5%,2%. The effects of Young's Modulus at 28 days and 60 days are presented.

Table 7 : Young's Modulus

Mix Proportions	Young's Modulus at 28 days (Mpa)	Young's Modulus at 60 days (Mpa)
A1	20347.2	24416.54
A2	15972.16	18367.9
A3	22314.7	25661.9
A4	29166.6	33541.59
A5	24999.7	29999.6

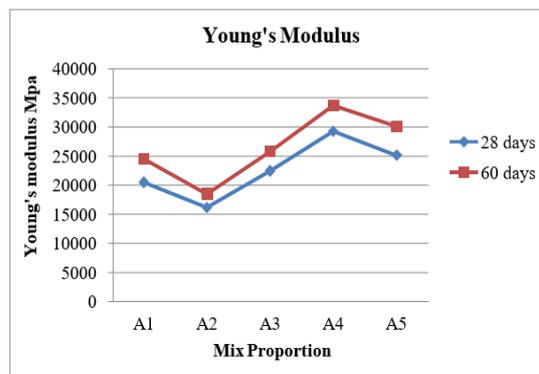


Figure 4 : young's modulus

D. Acid Attack Test

The Acid Attack check of M30 grade of concrete via replaces in everyday Portland cement with Natural silica fume and quartz powder like 5%,10%,15%, 20.and by Adding the percentages of Crimped metal fibers and polypropylene fibers like 0.5%,1%,1.5%,2% The consequences of compressive energy of A1, A2, A3, A4, and A5 concrete combinations examined at 60days and ninety days the statistics are introduced in the given beneath desk and graphical presentation for Acid Attack Test

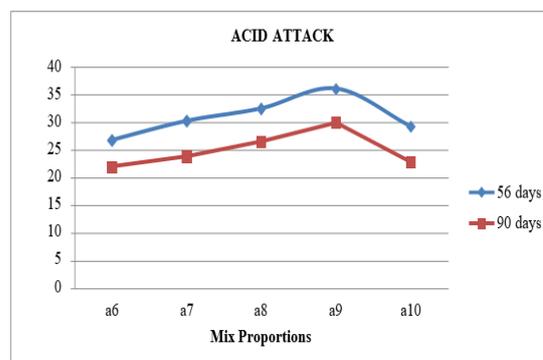


Figure 5 : Acid attack test

Table 7 : Acid attack test

Mix proportions	Compressive Strength N/mm ²	
	56days	90days
A1	26.73	21.87
A2	30.15	23.73
A3	32.40	26.42
A4	35.95	29.86
A5	29.15	22.67

E. Sulphate Attack Test

The Sulphate Attack take a look at of M30 grade of concrete by using replaces in regular Portland cement with Natural silica fume and quartz powder like 5%,10%,15%, 20.and by Adding the percentages of Crimped metal fibers and polypropylene fibers like 0.5%,1%,1.5%,2% The outcomes of compressive power of A1, A2, A3,A4, and A5 concrete combinations examined at 60days and ninety days the statistics are introduced in the given beneath desk and graphical presentation for Sulphate Attack Test

Table 8 : Sulphate Attack Test

Mix Proportions	Sulphate Attack	
	56days	90days
A1	29.35	23.78
A2	33.46	26.76
A3	35.63	28.27
A4	39.2	31.65
A5	31.19	25.80

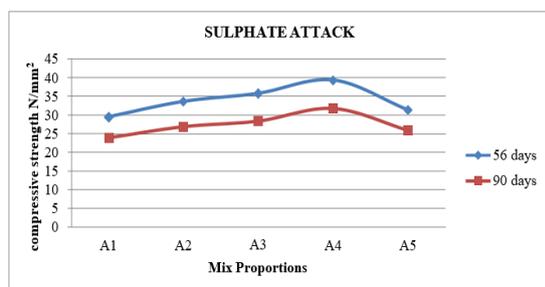


Figure 6 : Sulphate Attack Test

F. Alkalinity Attack Test

The Alkaline Attack check of M30 grade of concrete by using replaces in regular Portland cement with Natural silica fume and quartz

powder like 5%,10%,15%,20.and by Adding the percentages of Crimped metal fibers and polypropylene fibers like 0.5%,1%,1.5%,2% The outcomes of compressive energy of A1, A2, A3,A4, and A5 concrete combinations examined at 60days and ninety days the facts are introduced in the given under desk and graphical presentation for Alkaline Attack Test

Table 9 : Alkalinity Attack Test

Mix Proportions	Alkalinity Attack	
	56days	90days
A1	25.54	20.65
A2	28.70	23.40
A3	32.55	26.52
A4	37.15	31.21
A5	25.46	21.21

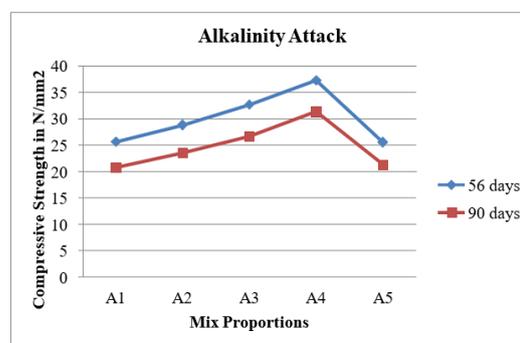


Figure 7 : Alkalinity Test

G. Rapid Chloride Permeability Test

The Rapid Chloride Permeability test was used for determining the chloride penetration resistance ion of the concrete is prescribed by ASTM C1202. The test results of chloride ion permeability were given below.

Table 10 : Rapid Chloride Permeability Test

Mix Proportions	RCPT for 28days (Mpa)	RCPT for 60days (Mpa)
A1	624.6	332.1
A2	1348.2	617.4
A3	1443.6	863.1
A4	1699.2	1073.7
A5	1753.2	1283.4



Figure 8 : Rapid Chloride Permeability Test

H. Water Permeability Test

The Water Permeability check of M30 grade of concrete by way of replaces in normal Portland cement with The Alkaline Attack check of M30 grade of concrete by way of replaces in regular Portland cement with Natural silica fume and quartz powder like 5%,10%,15%,20.andby Adding the percentages of Crimped metal fibers and polypropylene fibers like 0.5%,1%,1.5%,2% The outcomes of compressive strength of A1, A2, A3,A4, and A5 concrete combos examined at28 days and 60 days the statistics are introduced in the graphical presentation of Water Permeability.

Table 11: water permeability test

Mix Proportion	Depth of penetration (incm)		Coefficient of Permeability (Kinm/sec)	
	28days	60days	28days	60days
A1	0.35	0.3	1.57×10^{-13}	1.35×10^{-13}
A2	5.84	4.56	2.63×10^{-10}	2.05×10^{-10}
A3	5.67	4.30	2.55×10^{-10}	1.94×10^{-10}
A4	4.32	3.95	1.94×10^{-10}	1.77×10^{-10}
A5	6.30	5.61	2.8×10^{-10}	2.49×10^{-10}

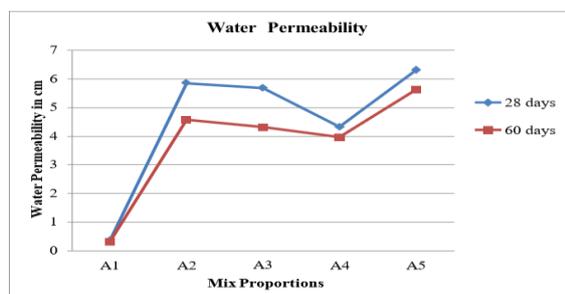


Figure 9 : Water Permeability Test

CONCLUSION

Crimped Steel Fibers are used low carbon bloodless drawn metal wire fibers designed to furnish concrete with temperature and shrinkage crack control, elevated shear power crack resistance of the concrete.

Poly propylene fibers functionality of long-lasting constructions to withstand weathering action, chemical attack, abrasion and other degradation. The roll of fibers in crack prevention.

Quartz used to be most frequent of all minerals is composed of silica dioxide it is a crucial of igneous and metamorphic rock.

Silica fume is made via combustion of silicon tetra chloride in a hydrogen oxygen flame. It is a very high-quality pozzolanic amorphous material.

In this investigation for M30 grade of concrete it can be calculated that the cement can be changed up to 5%, 10%, 15% and 20% of silica fume and quartz powder and crimped and poly propylene fibers are the usage of extra electricity reason up to 0.5%, 1%, 1.5% and 2%.

Compressive strength of concrete having greater energy on 1.5% fibers+ 15% silica fume and quartz powder when in contrast everyday concrete and closing percentages.

Split tensile strength of concrete having greater energy on 1.5% fibers+ 15% silica fume and quartz powder when in contrast regular concrete and last percentages.

Acid assault take a look at is having extra power on 1.5% fibers+ 15% silica fume and quartz powder when in contrast ordinary concrete and ultimate percentages. In this investigation fifty-six days compressive energy is extra than the ninety days strength.

Alkalinity check is having greater electricity on 1.5% fibers+ 15% silica fume and quartz powder when in contrast ordinary concrete and ultimate percentages. In this investigation fifty-six days compressive electricity is greater than the ninety days strength.

Sulphate assault check is having greater energy on 1.5% fibers+ 15% silica fume and quartz powder when in contrast ordinary concrete and final percentages. In this investigation fifty-six days compressive strength is extra than the 90 days strength

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Modulus of elasticity of concrete in accordance to stress-strain curve 28 days of power make bigger 1.5% fibers+ 15% silica fume and quartz powder when in contrast ordinary concreteand final percentages.

Durability of concrete as Rapid Chloride Permeability Test at 28 days chloride penetration is greater than fifty six days.

The water permeability of concrete with 1.5% fibers +15% silica fume and quartz powder 28 days is extra than fifty-six days.

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