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A Comparative Study on Strength and Durability Parameters of a Blended Concrete with the Utilization of Fibers

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Abstract - *Considering the increase in demand for the developing of alternative construction materials due to growing environmental concerns. Concrete is generally produced by the binder called ordinary Portland cement (OPC). As we know that the production of OPC will arise several environmental issues in which during the manufacture of one tone of OPC will emit 0.8 to 1 tons of carbon dioxide due to the calcination of lime stone and combustion of fossil fuel. Hypo sludge is the waste disposed material from paper industry and fly ash is the by-product of coal from thermal power plant. Disposing of these materials are the major problems due to its fineness, hence an effort is made to utilize these finer materials (hypo sludge +fly ash) by replacement with cement of 0%,5%,10%,15%,20%of individual percentages by weight of cement for M25 mix to know the mechanical properties by taking the optimum value the specimens are tested with addition of sisal fibers, steel fibers & glass fibers at percentages of 0.5%, 1%,1.5%,2% by weight of cement at the age of 7,14,28 days of curing. For investigation purpose cubes, cylinders, prisms are casted for strength parameters by compressive strength, split tensile strength and flexural strength. Then the durability parameters are were carried out to know the service life of the concrete structure by the Percentage loss in compressive strength, Percentage loss of weights by considering the Durability tests such as acid attack test, alkaline attack and sulphate attack test at the age of 28, 56 and 90days.*

Key Words: Hypo sludge, Fly ash, sisal fibers, steel fibers, glass fibers, strength parameters and Durability

1. INTRODUCTION

Concrete is the most widely used material for the purpose of construction in the world. It is a composite constructive material which consists of aggregates, cement and water. The word concrete comes from the Latin word " the "con"-(together) and "crescere"- (to grow).

1.1 HYPO SLUDGE& FLYASH

Hypo sludge and flyash are the materials which are to be obtained from the disposed product of a paper and coal based thermal industry. It contains the binding nature of a cementations property which can be supposed to use as cement in the construction industry.

1.2 FIBERS

The fibers which are to be used as a additive mixture to the weight of cement. Sisal fibers attain handy ductility; hence, they might control plastic cracks. Its length 36mm ,dia. 0. 6mm and aspect ratio 60. Steel fibers are used increase strength and reduce cracking and its length 35mm and dia. 0.45mm and aspect ratio 80.Glass fiber-reinforced cement utilization fiber glass about period 12mm of dia Also length 0. 14mm for aspect ratio 857.

1.3 Durability

Durability is the one of the main property which is considered as a long service life. According to aci committee 201, durability of port-land cement concrete is defined as its ability to resist against weathering action, chemical attack, abrasion or any other type of deterioration.

1.4OBJECTIVES

•To study the mechanical properties of normal concrete and the blended concerete with hyposludge and flyash of M25 grade of concrete and to compare the optimum values of a fibered blended concrete.

•To study the durability properties with Acid test Alkaline test and sulphate attack and compare the test results with the conventional concrete

2. Materials and Its Properties

2.1Ordinary Portland Cement:

Cement is a fastener and is characterized as a finely ground inorganic material which, when blended in with water, forms a paste which sets and solidifies by methods for hydration reaction

Table no: 01 Property's of cement

PROPERTY	VALUE OBTAINED EXPERIMENTALLY	As per code
Fineness of modulus	29%	30%
Normal consistency	4%	Max 10%

Initial setting time	31 min	MIN 30min
Final setting time	540min	MAX 600min
Specific gravity	3.12	3.15

2.2Fly Ash

Table no: 02Physical properties of fly ash

PROPERTY	VALUE OBTAINED	VALUE AS PER IS 12269-1987
SPECIFIC GRAVITY	2.1	2.1 - 3.0
FINENESS MODULUS	5%	Max 10%
NORMAL CONSISTENCY	21%	30%
INITIAL SETTING TIME	30	MIN 30min
FINAL SETTING TIME	520	MAX600min

2.3Hypo Sludge

Table no: 03 Physical properties of hypo sludge

Physical properties	Results
(a)Initial setting time	38 minutes
(b)Final setting time	625 minutes
Normal consistency	26%
Fineness modulus	9%
Specific gravity	2.8

2.4Coarse Aggregate

The coarse aggregate is a substance which is granulated from the rock of the quarrfication and the stones which are crushed. The 12.5 and 20 mm aggregates are used.

Table no: 04 Physical properties of Coarse aggregate

Physical properties	Results
Specific gravity	2.84
Fineness modulus	6.63
Water absorption	0.44%
Maximum size	20 mm

2.5Fine Aggregate

The sand is the material which is obtained from the river beds with a least size of dimensions. The fine aggregate along with the hydrated cement paste fill the space between the coarse aggregate.

Table no: 05Physical properties of Fine aggregate

Physical properties	Results
Specific gravity	2.6
Fineness modulus	2.63
Water absorption	0.50%
Zone	III

2.6WATER

Combining water with a cementitious material forms a cement paste by the process of hydration. The cement paste bind the aggregate together, fills voids within it, and makes it flow more freely.

2.7HCL

Hydrochloric acid with concrete produces calcium chloride, which precipitate as gypsum and nitric acid with concrete gives rise to calcium nitrate, as a result of this reaction, structure of concrete gets damaged. cement concrete is acid resistant. In general practice, degree of attack increases as the concentration of acid increases.

2.8NaOH

Sodium hydroxide is a highly caustic substance that is used to neutralize acids and make sodium salts. , It is in a form of white crystalline odorless solid which absorbs moisture from the air.. When it was dissolved in water or acid it liberates substantial heat, which may be sufficient to ignite combustible materials. Sodium hydroxide is very corrosive.

2.9$MgSO_4$

Magnesium sulfate is an inorganic salt with the formula MgSO4 (H2O)X where 0≤x≤7. It is often encountered as the sulfate mineral epsomite (MgSO4•7H2O), commonly called Epsom salt.

3 EXPERIMENTAL PROGRAM

3.1Casting of specimens

After the proportioning of the concrte mix which is to be determined from the physical properties of the concrete materials then the strength parameters are determined by the use of specimens Cubes, Beams and Cylinders.

3.2COMPRESSIVE STRENGTH TEST

The compression test is the most commonly used test on hardened concrete specimens of size 150mmx 150mmx 150mm to determine the compressive strength of the concrete. After the certain period of the curing, the specimens are subjected to the surface drying. The specimens are placed in a compressive testing machine and the load is applied on the specimen.

3.3SPLIT TENSILE STRENGTH TEST

The split tensile strength of the concrete is determined by the cylinder specimens of 150mm diameter and 300mmheight. After the curing period the specimen is placed in a horizontal direction in a tension strength machine with a max load of 1000 KN. The ultimate load at which the specimen fails is note as the load and the split tensile strength is calculated.

Flexural Strength Test

Flexural strength of concrete is done by the two - point loading method. The standard beam moulds of 100mmx100mmx500mm were casted and tested the flexural strength at a certain age after the curing period.

4. Results & Discussions:

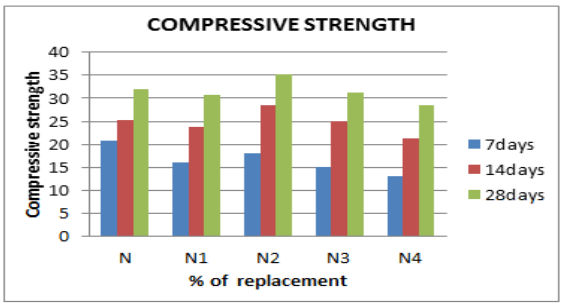
After curing we do tests on concrete the following are the tests on the concrete

- Compressive strength of concrete
- Split tensile strength of concrete
- Flexural strength of concrete
- Durability test

4.1COMPRESSIVE STRENGTH TEST

Table no:06 Compressive strength of concrete

S.No	Mix Designation	Compressive strength (N/mm^2)		
		7days	14 days	28days
1	N	20.8	25.2	32.02
2	N-1	16.01	23.7	30.8
3	**N-2**	**18.1**	**28.44**	**35.2**
4	N-3	15.2	25.1	31.3
5	N-4	13.1	21.2	28.4

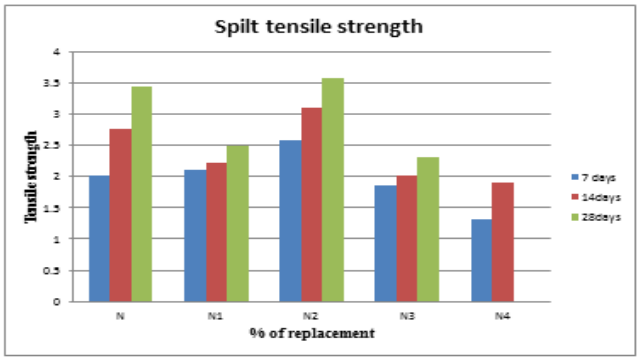


Graph no 1: Compressive strength of concrete

4.2SPLIT TENSILE STRENGTH TEST

Table no:7 Split tensile strength of concrete

S.No	Mix Designation	Spit Tensile Strength(N/mm^2)		
		7days	14 Days	28days
1	N	2.01	2.76	3.45
2	N-1	2.11	2.22	2.48
3	N-2	2.59	3.11	3.57
4	N-3	1.85	2.01	2.32
5	N-4	1.31	1.9	2.16

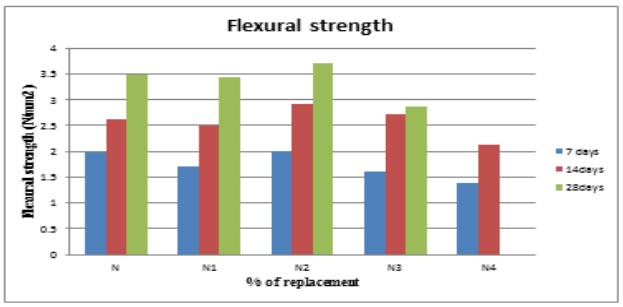


Graph no 2: Split Tensile Strength of concrete

4.3FLEXURAL STRENGTH TEST

Table no: 8 flexural strength of concrete

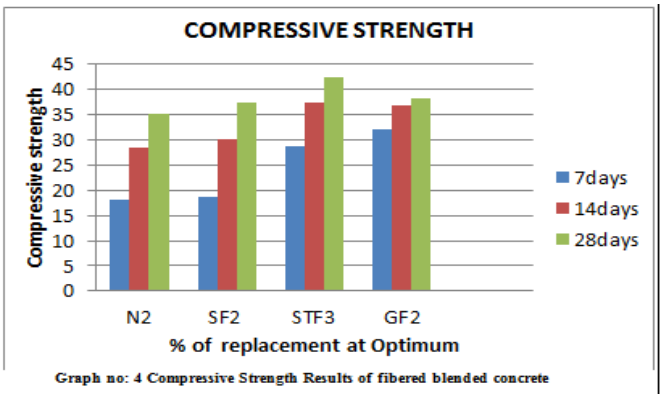
S.No	Mix Designation	Flexural strength (N/mm^2)		
		7days	14 days	28days
1	N	1.99	2.62	3.5
2	N-1	1.71	2.51	3.44
3	N-2	2.01	2.92	3.71
4	N-3	1.61	2.71	2.87
5	N-4	1.39	2.12	2.31



Graph no 3: Flexural Strength of concrete

Table no:9 Compressive Strength Results of fibered blended concrete

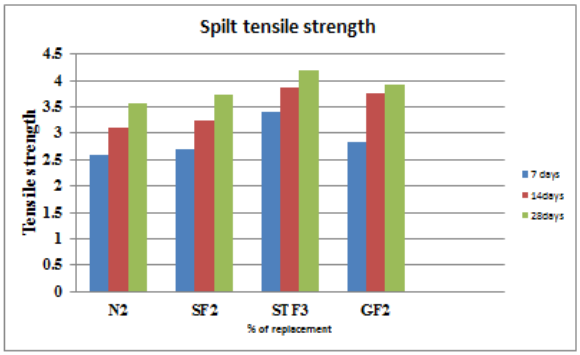
S. No	No Of Days	N2 (MPa)	Sisal Fiber (MPa)	Steel Fiber(MPa)	Glass Fiber (MPa)
			SF2	STF3	GF2
1	7	**18.1**	**18.7**	**28.64**	**32.2**
2	14	**28.4**	**30.1**	**37.48**	**36.8**
3	28	**35.2**	**37.2**	**42.35**	**38.1**



Graph no: 4 Compressive Strength Results of fibered blended concrete

Tableno:10Split Tensile Strength Results of fibered blended concrete

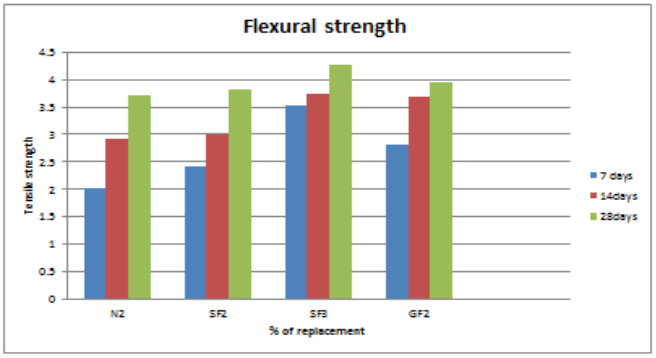
S. No	No Of Days	N2 (MPa)	Sisal Fiber (MPa)	Steel Fiber (MPa)	Glass Fiber (MPa)
			SF2	STF3	GF2
1	7	2.59	2.69	3.41	2.84
2	14	3.11	3.24	3.86	3.76
3	28	3.57	3.72	4.18	3.91



Graph no: 5 Split Tensile Strength Results of fibered blended concrete

Table no: 11 Flexural Strength Results of fibered blended concrete

S. No	No Of Days	N2 (MPa)	Sisal Fiber (MPa)	Steel Fiber(MPa)	Glass Fiber (MPa)
			SF2	STF3	GF2
1	7	2.01	2.42	3.52	2.82
2	14	2.92	3.01	3.74	3.68
3	28	3.71	3.82	4.27	3.94



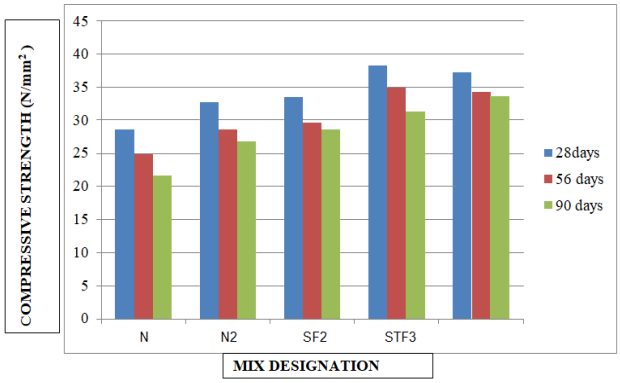
Graph no: 6 Flexural Strength Results of fibered blended concrete

DURABILITY TEST RESULTS:

Comparison of compressive strength between the normal concrete and Optimum Percentage Concrete Mixes Due To Acid attack, Alkaline attack and Sulphate attack.

Table no:12 Durability test of Acid attack

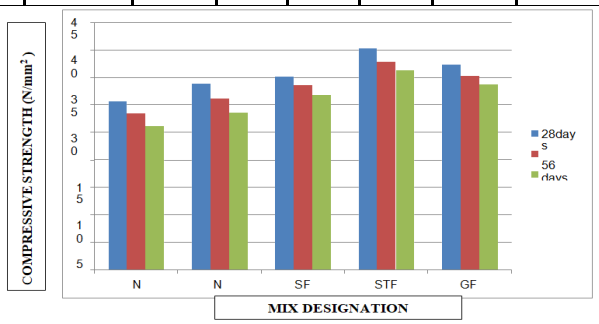
Sl. No	Mix Designation	28 Days (N/mm²)		56 Days (N/mm²)		90 Days (N/mm²)	
		0% HCL	5% HCL	0% HCL	5% HCL	0% HCL	5% HCL
1	N	32.02	28.65	32.85	24.82	33.27	21.68
2	N2	35.2	32.68	35.82	28.62	36.31	26.83
3	SF2	37.24	33.42	37.87	29.58	38.62	28.64
4	STF3	41.35	38.21	41.83	34.85	42.23	31.28
5	GF2	39.1	37.28	39.42	34.22	39.82	33.65



Graph No: 7 DURABILITY TEST OF ACID ATTACK

Table no:13 Durability test of Alkaline attack

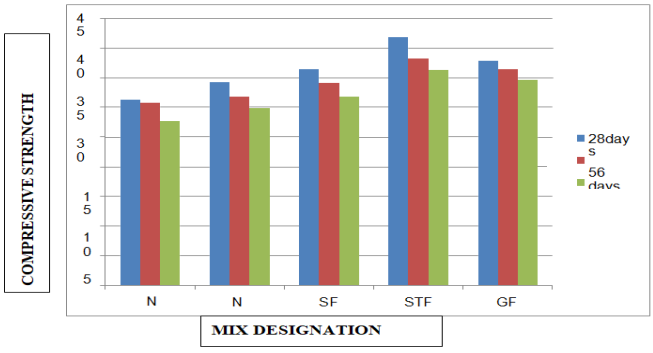
Sl. No	Mix Designation	28 Days (N/mm²)		56 Days (N/mm²)		90 Days (N/mm²)	
		0% NaOH	5% NaOH	0% NaOH	5% NaOH	0% NaOH	5% NaOH
1	N	32.02	30.62	32.85	28.43	33.27	26.14
2	N2	35.2	33.87	35.82	31.08	36.31	28.52
3	SF2	37.24	35.2	37.87	33.57	38.62	31.82
4	STF3	41.35	40.27	41.83	37.85	42.23	36.28
5	GF2	39.1	37.28	39.42	35.22	39.82	33.65



Graph No: 8 Durability Test Of Alkaline Attack

Table no: 14 Durability test of Sulphate attack

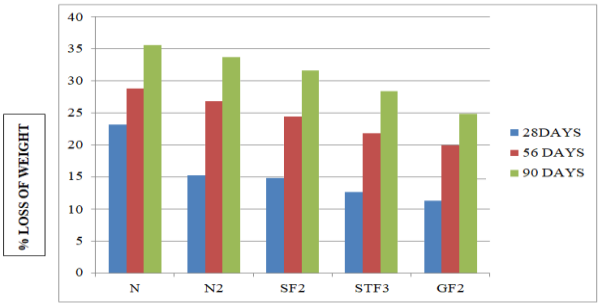
Sl. No	Mix Designation	28 Days (N/mm²)		56 Days (N/mm²)		90 Days (N/mm²)	
		0% MgSO4	5% MgSO4	0% MgSO4	5% MgSO4	0% MgSO4	5% MgSO4
1	N	32.02	31.26	32.85	30.82	33.27	27.68
2	N2	35.2	34.26	35.82	31.86	36.31	29.84
3	SF2	37.24	36.41	37.87	34.12	38.62	31.86
4	STF3	41.35	41.04	41.43	38.26	41.62	36.27
5	GF2	39.1	37.86	39.42	36.43	39.82	34.61



Graph No: 9 Durability Test Of Sulphate Attack

Table no; 15 Loss of weight when specimen placed in HCL

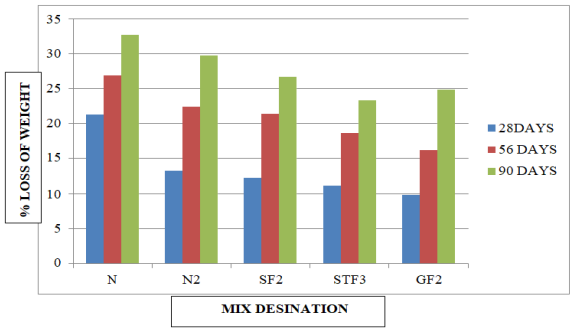
S.NO	NO.OF.DAYS	N	N2	SF2	STF3	GF
1	28	23.2	15.21	14.84	12.68	11.26
2	56	28.84	26.83	24.42	21.8	19.90
3	90	35.61	33.7	31.67	28.41	24.82



Graph No: 10 % Loss Of Weight In Acid Attack

Table no: 16 Loss of weight when specimen placed IN NaOH

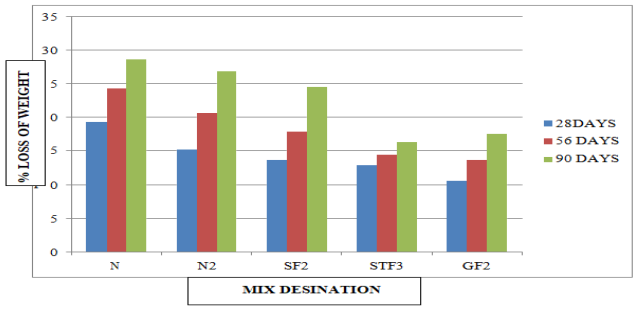
S.NO	NO.OF. DAYS	N	N2	SF2	STF3	GF
1	28	21.23	13.23	12.29	11.13	9.84
2	56	26.84	22.38	21.42	18.6	16.21
3	90	32.61	29.72	26.67	23.26	18.92



Graph No: 11 % Loss Of Weight In Alkaline Attack

Table no: 17 Loss of weight when specimen placed in MgSO4

S.NO	NO.OF. DAYS	N	N2	SF2	STF3	GF
1	28	19.28	15.26	13.63	12.85	10.62
2	56	24.29	20.65	17.86	14.52	13.65
3	90	28.64	26.83	24.56	16.27	17.56



Graph No: 12 % Loss Of Weight In Sulphate Attack

5. CONCLUSIONS

1. The strength parameters are increased by the replacement of cement with hypo sludge & fly ash is done from 0% to 40%. The maximum compressive strength for 28 days is achieved for 20%replacement of cement N2.
2. At the optimum percentage of 20% replacement the strength parameters are increased that 10, 3.5 & 6 percentages of compressive, split tensile and flexural strength when compared with the normal concrete N
3. At the optimum percentage of N2 the addition sisal fibers at 1% (SF2)strength parameters are increased that 5.5, 4 & 3 percentages of compressive, split tensile and flexural strength when compared with the N2
4. At the optimum percentage of N2 the addition steel fibers at 1.5% (STF3)strength parameters are increased that 17.2, 14.6 & 13 percentages of compressive, split tensile and flexural strength when compared with the N2
5. At the optimum percentage of N2 the addition glass fibers at 1% (GF2) strength parameters are increased that 7.7, 8.69 & 5.8 percentages of compressive, split tensile and flexural strength when compared with the N2
6. The compressive strength of normal concrete (N) specimens after immersed in 5% HCL, NaOH and MgSO4 solution is reduced when compared to blended and fibered blended concrete.

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