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To Evaluate Strength Properties of Fibre Reinforced Concrete with Additives Using Different Curing Agents

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ABSTRACT
Curing in concrete plays the main role in developing strength of concrete and it helps in maintaining moisture contented in concrete during its early ages in order to enhance the required properties. A concrete curing agent forms a membrane over the top of the concrete surface. This stops the water on the surface of the concrete evaporating too quickly and hence helps to reduce cracking and dusting. Since concrete curing agent manages the behaviour of water in the concrete. The present experiment is carried out to investigate the effect of different curing agents on FRC with a replacement of cement by met kaolin at 10% and 30% of fly ash. Tests to be conducted by adding 0.5%, 0.75% and 1% of steel fibres, And different dosages of curing agent polyethylene glycol-400 as 0.5%, 0.75% and 1% 0f weight cement and another curing agent CURE WB was also used for same mix proportions. Then the fresh, harden and durability characteristics have been studied
KEYWORDS-Curing Agents (Polyethylene Glycol-400, cure WB), Metakaolin, Fly Ash, Steel Fibres, Water Reducing Admixture (Conplast SP-430 BIS).

I. INTRODUCTION

Concrete is a very essential building material used extensively in the construction industry worldwide, thanks to its strength properties. Hardening of concrete plays an essential role in the durability plus other performance of concrete, Due to incorrect curing in concrete the main characteristics of concrete effects, Due to modernization in the construction industry and due to lack of water, External curing becomes difficult now, so it will be necessary to find alternative curing methods for concrete So self-curing of concrete is a stand out amongst other techniques nowadays to accomplish the quality and additionally the toughness properties of concrete by utilizing numerous building chemicals accessible available we can accomplish self-hardening of concrete.

II. LITERATURE REVIEW

IN this investigation the mechanical properties of self-curing operators are explored. By the expansion of silica fume and two materials as self-curing specialists. They are pre-drenched lightweight aggregate as 0%,10%,15%,20% of volume of sand and polyethylene glycol at the rate of 1%,2%,3% by weight of cement the examined comes about demonstrates that polyethylene glycol self-curing specialist gives higher mechanical properties then pre-splashed lightweight aggregate [3]fresh, harden & durability study on different grades of concrete. By incomplete replacement of cement by fly ash that is 30%. The different curing agents in this investigation used are two biomaterials namely caltrop's gignetea, Spinacia oleracea and polyethylene glycol taken as 0.24%, 0.6%, 0.3% by wt. of cement the results appear that the strength varies from normal strength to self-curing concrete is then 1 after 28 days and 1.15 after 56 days [2] quality attributes of concrete essentially harden properties of concrete with the expansion of curing agent has been contemplated. at that point, the outcomes are contrasted and the typical concrete the outcomes demonstrates that concrete with PEG as curing agent gives preferred outcomes over ordinary curing [4]the different mechanical features of concrete by varying different dosages of PEG-400 varies of 0% to 1.5% the optimum dosage was found to be 1% [6] the fresh and hardening property of concrete the normal and high-quality concrete cast with the agent of self-curing have been studied and compared with ordinary cured concrete. For normal mix M20, M30, M40 has been selected for high strength M_{50}, M_{70} and M_{80} was adopted in this paper different curing agents are used they are polyethylene glycol and sorbitol in these curing agent's polyethylene glycol was found more effective the results show that workability and hardened properties of concrete increases using agents of self-curing and agents of self-curing found economical [7]

III. OBJECTIVES OF THE WORK

1. To develop the mix proportions for M50 grade concrete with partial replacement of cement with fly ash & Metakaolin as well as the addition of fibres
2. To investigate the effect of different types of curing agents on fresh and harden property of concrete
3. To study the effect of different types of curing agents in concrete on durability properties
4. To develop the environmental friendly concrete by reducing the amount of cement used in concrete

IV. MATERIALS USED

4.1 Cement: In this research work 53 grades OPC having trade name MAHA is used for all concreting purposes. That was good in colour. The tests on cement were done as per standards. The physical properties are shown below.

Table 1:- Physical properties of cement

SL.NO	Properties	Results of Conducted Tests
1	Fineness	8%
2	Specific Gravity	3.03
3	Normal consistency	33%
4	Initial setting time	50min
5	Final setting time	400min

4.2 Fly Ash: -Fly Ash was taken from RTPS. The test on fly ash is done as per IS 3812:2003(Part I And II) the Physical property as shown below.

Table 2:- Physical properties Fly Ash

SL.NO	Property	Test Results
1	Specific gravity	2.03
2	Fineness	350 m^2/kg

Table 3:- Chemical Composition of Fly Ash

SL.NO	Constituents	Percentage (%)
1	Silica(Si)	55-60
2	Alumina(Al)	20-35
3	Calcium oxide(Cao)	5-15
4	Ferric oxide(Fe_2O_3)	4-10

4.3 Metakaolin: -It is a Pozzolanic material. It is a mineral of kaolinite acquired by calcination of kaolinite dirt. The Metakaolin used in this work has the specific gravity 2.5

Table 4:-Chemical Composition of Metakaolin

SL.NO	Constituents	Percentage (%)
1	SiO_2	55.50
2	Al_2O_3	36.50
3	Fe_2O_3	2.00
4	TiO_2	1.00
5	K_2O	1.70
6	Na_2O	0.10

4.4 Fibres:-Double end hooked steel fibres with an aspect ratio of 50; length 5cm and diameter 1mm were used in this research work

4.5 Coarse aggregates (CA):-The aggregate size more than 4.75mm they are called as coarse aggregates. In this exploration work, 20mm downsize aggregates are utilized.

Table 5:- Physical properties of Coarse Aggregates

Properties	Results of the test conducted
Specific Gravity.	2.68
Bulk density($kg/m^{3)}$	2086
Water absorption	0.5

4.6 Fine aggregates (FA): -For this investigation, fine aggregates are occupied from Raichur district from river Krishna. It is found under zone II. The physical properties are as shown below.

Table 6:- Physical Property of Fine Aggregate

SL.NO	Properties	Results of the test conducted
1	Specific. Gravity	2.65
2	Finesse Modulus	3.36
3	Water absorption	0.9

4.7 Polyethylene glycol-400(PEG-400):-In this examination work PEG is utilized as a water-based curing agent. Polyethylene glycol is non-dangerous, unscented, unbiased, grease, non-unpredictable and non-disturbing and is utilized as a part of a progression of pharmaceutical enterprises

Table 7:- Properties of PEG-400

SL.NO	Description	Properties
1	Molecular weight	400
2	Specific gravity	1.13

4.8 CURE WB: -WHITE/CLEAR is a white fluid for splashing on newly poured concrete or on a recently uncovered concrete surface. To frame a brief film that will hold enough moisture for viable curing to happen. It is basically a low thickness wax emulsion. This waterproof film avoids over the top vanishing of water and causes the concrete to hydrate all the more adequately. It ensures and its crisply put concrete against ideal hydration prompting more grounded end hydration item.

Table 8:-Physical Properties of CURE WB

SL.NO	Properties	Results
1	Appearance	White liquid
2	Appearance when applied	clear
3	Curing efficiency	>90%

4.9 Superplasticizer:-In this research work Conplast SP-430 is used as a superplasticizer. 1% of the cementitious material will be the dosage of superplasticizer. That can reduce water up to 29%
4.10 Water:-In this work potable water is used for the purpose of mixing

V. MIX DESIGN FOR M_{50} GRADE OF CONCRETE

The experimental program was designed to compare the mechanical properties i.e. compressive strength, split tensile strength and flexural strength of high strength concrete with an M_{50} grade of concrete and with different replacement levels OPC-53 grade with fly ash by 30% and Metakaolin with 10%. With the addition of fibers by 0.5%, 0.75% and 1% and here two curing agents are used
1. Polyethylene glycol-400 is added at a 0.5%, 0.75% and 1% by weight of cement 2. CURE WB

Table 7:-Mix Proportion (kg/m^3) and Mix Ratio of M50 Grade Concrete

Cement	Fine Aggregate	Coarse Aggregate	Water
412	793.6	1137.6	156.73
1	1.92	2.76	0.38

Table 8:-Trial mix proportions Poly Ethylene Glycol-400 as curing agent

Proportions	Fly Ash	Metakaolin	Fibres	PEG-400
Mix-1(M_1)	30%	10%	0.5%	0.5%
Mix-2(M_2)	30%	10%	0.75%	0.75%
Mix-3(M_3)	30%	10%	1%	1%

Table 9: -Trial mix proportions CURE WB as a curing agent

Proportions	Fly Ash	Metakaolin	Fibres
Mix-1(M_1)	30%	10%	0.5%
Mix-2(M_2)	30%	10%	0.75%
Mix-3(M_3)	30%	10%	1%

VI. RESULTS AND DISCUSSION

5.1 Test on fresh concrete: The fresh property of concrete test is usually performed to verify the workability characteristics of mixed fresh concrete of any quality on site prior to concreting. In this project, the slump cone test and compaction factor are performed to find workability for added M_{50} grade concrete by partially replacing the fly ash, Metakaolin as a cement and adding a curing agent and fibres

5.1.1 Compaction Factor Test: Workability gives an idea of the capability of being worked. That workability of concrete can be found out by compaction factor test. This test consists of essentially applying a standard measure of work to standard nature of concrete and estimating the resultant compaction

5.1.2 Slump cone test: Vertical settlement of unsupported concrete is known as the slump. The slump will measure the consistency or workability of concrete mix. Normally concrete is designed for certain workability in terms of slump depending upon site requirement.

Table 10: -Results of compaction factor and slump cone for Curing agent PEG-400

Types of Mixes	Compaction factor	Slump(mm)
M0	0.85	75
M1	0.9	60
M2	0.92	55
M3	0.95	52

Table 11: -Results of compaction factor and slump cone for Curing agent CURE WB

Types of Mixes	Compaction factor	Slump(mm)
M0	0.85	75
M1	0.82	78
M2	0.75	82
M3	0.70	85

5.2 Tests on Harden Concrete

5.2.1 Compressive strength

This is one of the essential properties of the concrete. Alternate properties of concrete have the unmistakable association with compressive strength. On the off chance that the compressive strength of concrete is enhanced at that point there is a change in different properties of concrete, in this manner compressive strength of the concrete is a basic test.

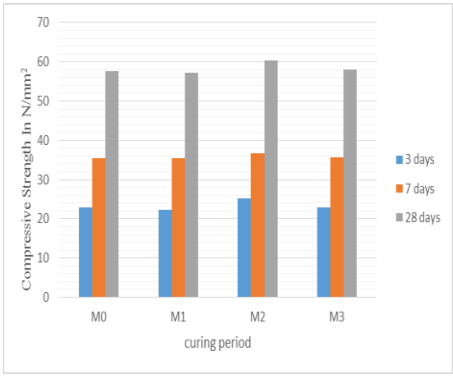
Cube of size 150*150*150mm is cast according to different mix proportions of this research work. After curing for a number of days these cubes are tested in a compressive machine, to get a desired compressive strength for different days of curing.

Table 12:-Compressive Strength for Poly Ethylene Glycol-400

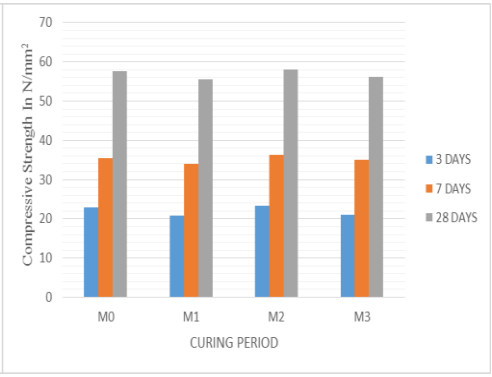
Type of mixes	3 Days N/mm^2	7 days N/mm^2	28 days N/mm^2
M0	22.9	35.53	57.66
M1	22.37	35.40	57.32
M2	25.18	36.81	60.35
M3	22.82	35.70	58.03

Table 13:-Compressive Strength for CURE WB

Type of mixes	3 Days N/mm^2	7 days N/mm^2	28 days N/mm^2
M0	22.90	35.53	57.66
M1	20.73	34.07	55.65
M2	23.25	36.29	57.99
M3	21.05	34.96	56.14



Graph 2: Compressive Strength for Curing Agent PEG-400



Graph 1: Compressive Strength for Curing Agent CURE WB

5.2.2 Split Tensile Strength

The tensile strength is one of the fundamental & significant properties of concrete. The concrete is not frequently accepted to oppose the direct tension since of its low tensile strength and delicate nature. Therefore, in the design of structural concrete is exploited so as not to rely on its tensile strength which is low. Since most structural concrete contains steel reinforcement which takes care of tensile strength.

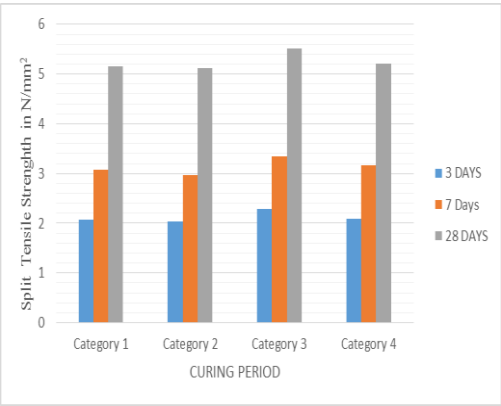
To perform this test cylindrical mould of size 150mm diameter 300mm height is taken and concrete is cast, then the specimen is tested in the compressive testing machine at 3.7 and 28 days. Respectively

Table 14:-Split tensile Strength for Poly Ethylene Glycol-400

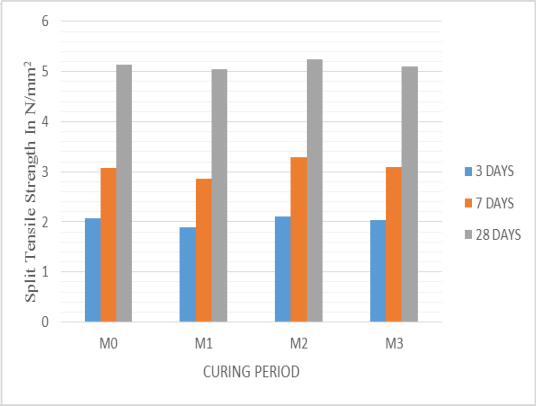
Type of mixes	3 Days N/mm^2	7 Days N/mm^2	28 Days N/mm^2
M0	2.067	3.08	5.15
M1	2.03	2.96	5.12
M2	2.28	3.34	5.51
M3	2.09	3.17	5.21

Table 15:-Split tensile Strength for CURE WB

Type of mixes	3 Days N/mm^2	7 days N/mm^2	28 days N/mm^2
M0	2.067	3.08	5.15
M1	1.90	2.86	5.04
M2	2.10	3.29	5.24
M3	2.03	3.1	5.11



Graph 4.3: Split Tensile Strength for Curing Agent Peg-400



Graph 4.4: Split Tensile Strength for Curing Agent CURE WB

5.2.3 Flexural Strength Test

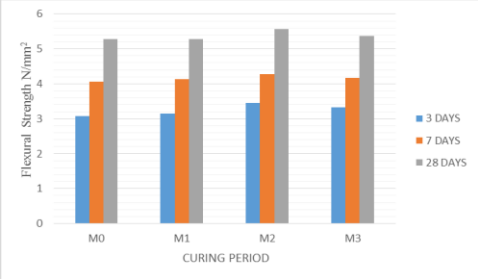
The test is important to discover the flexural quality of concrete. The specimen of size 150*150*700mm was utilized to figure the flexural quality of concrete.

Table 16:-Flexural Strength for Poly Ethylene Glycol-400

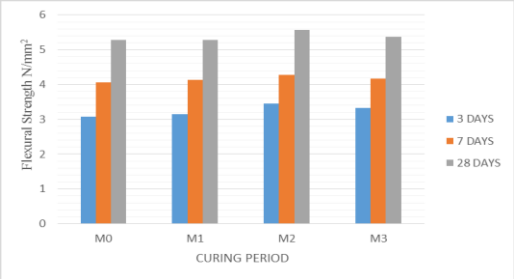
Type of mixes	3 days N/mm^2	7 days N/mm^2	28 days N/mm^2
M0	3.08	4.06	5.28
M1	3.14	4.13	5.29
M2	3.45	4.27	5.56
M3	3.32	4.17	5.37

Table 17:-Flexural Strength for CURE WB

Type of mixes	3 days N/mm^2	7 days N/mm^2	28 days N/mm^2
M0	3.08	4.06	5.28
M1	3.03	4.06	5.15
M2	3.34	4.20	5.33
M3	3.18	4.13	5.28



Graph 5: Flexural Strength for Curing Agent Peg-400



Graph 6: Flexural Strength for Curing Agent CURE WB

5.2.4 Acidic attack: After 28 days of curing the examples were weighed precisely. At that point, they were subjected to an acidic assault of pH=2 and pH=3 for 60 days. After 60 Days all examples were taken out and were all samples weight taken together with water and dried, at this stage they were weighed precisely.

Table 18: -Weight loss for Sulphate attack for Curing agent PEG-400

Mix Designation	The weight of specimens before acidic attack W1	The weight of specimen after subjecting to acid attack W2	Percentage weight loss
M0	8.48	8.45	0.353
M1	8.42	8.39	0.356
M2	8.46	8.44	0.236
M3	8.05	7.99	0.745

Table 19: -Weight loss for Sulphate attack for Curing agent CURE WB

Mix Designation	The weight of specimens before acidic attack W1	The weight of specimen after subjecting to acid attack W2	Percentage weight loss
M0	8.48	8.45	0.353
M1	8.12	8.08	0.492
M2	8.41	8.37	0.713
M3	8.45	8.4	0.591

VII. CONCLUSION

1. In this research, the fresh property of M50 Grade concrete that is workability is going on increasing by the increase in the percentage of curing agent polyethylene glycol-400
2. The compressive strength of concrete after 28 days of curing the curing agent Polyethylene glycol-400 is found more effective then compare to CURE WB
3. The compressive strength of concrete with curing agent polyethylene glycol-400 was found to increase by 4.66% than conventional concrete
4. The optimum dosage of curing agent polyethylene glycol-400 was found to be 0.75% weight of cement
5. The optimum dosage of fiber was also found to be 0.75% weight of concrete
6. The compressive strength of concrete using CURE WB as a curing agent was found to increase by 0.572% than conventional mix after 28 days of curing

7. Split tensile strength for concrete using polyethylene glycol-400 as a curing agent was found to increase by 6.99% than the conventional mix after 28 days
8. Split tensile strength of concrete using curing agent CURE WB was found to increase by 1.74% than conventional concrete after 28 days of curing
9. Flexural strength of concrete using curing agent polyethylene glycol-400 was found to increase by 5.30% than conventional mix after 28 days of curing
10. Flexural strength of concrete using curing agent CURE WB was found to increase in 0.95% than normal conventional concrete after 28 days of curing
11. The acidic attack is more Resistance for concrete with curing agent PEG-400 then to curing agent.

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