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STUDY ON STRENGTH CHARACTERISTICS OF SELF CURING CONCRETE INCORPORATED WITH FLY ASH

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Abstract - *Water curing is the most effective curing method to promote continuous hydration of cement and cement supplementary materials in concrete. In practice, this ideal curing condition is provided for a limited period in concrete construction. Membrane curing is used to prevent the drying of freshly placed concrete surface and to minimize the risk of plastic shrinkage cracking, particularly in concrete slabs. Self-curing admixture is relatively new chemical admixture to improve the water retention in concrete. This paper discusses the results of an experimental investigation into the evaluation of a self-curing admixture in a flowing fly ash concrete. Polyethylene Glycol-400(PEG-400) is used in this experiment as a self curing agent. The objective of the present experimental study is to analyze the possibility of using fly ash in the place of cement in self curing concrete up to 30%. This experimental study was carried out on the two mixes conventional mix, self curing concrete mix with replacement of cement by fly ash up to 30% with PEG-400 varying from 0.5% 1.0%, 1.5% and 2% on M25 mix. The self-curing admixture was found to improve the compressive strength of concrete under air-stored condition. The lowest drying shrinkage for self-curing concrete indicates the effectiveness of water retention property of the self-curing admixture and it is concluded that a self-curing admixture is a useful ingredient in concrete mixes when conventional water curing procedure is difficult to perform and it also offers improved workability of concrete mix.*

Key Words: **Curing, Polyethylene Glycol-400(PEG-400), Fly ash, Self-curing admixtures, Compressive strength, Shrinkage, Water Retention, and Workability**.

1. INTRODUCTION

Concrete is an artificial material in which the aggregates both fine and coarse are bonded together by the cement when mixed with water. The concrete has become so popular and indispensable because of its inherent properties. Its great versatility and relative economy in filling a wide range of needs has made it is a very competitive building material. Prevention of curing in construction saves a large quantity of water. So, self curing concrete is the water management system in construction process. Water utilized in the concrete mixing stage, is enough for the curing of concrete. Polyethylene Glycol-400 is used as a self curing agent in this self curing concrete. Because of properties like harmless, water soluble, easy to handle, etc., many observations have revealed that PEG-400 is the best self curing agent at 0.5-2.0% by weight of cement. At this proportion, strength of self curing concrete is more than the conventional concrete. In the current project, PEG-400 is used as a self curing admixture by varying from 0.5% 1.0%, 1.5% and 2% by weight of cementitious material on M25 mix. Nowadays fly ash is used as an alternative cement material. Fly ash used in this self curing concrete and study the changes in strength characteristics of this concrete. This helps us in the study of "fly ash behavior in self curing concrete up to 30% replacement by weight of cement".

1.1 Need and Scope of Study

Curing of concrete is maintaining satisfactory moisture content in concrete during its early stages in order to develop the desired properties. However good curing is not always practical in many cases. The aim of this investigation is to evaluate the use of water-soluble Polyethylene glycol-400 as self-curing agents. The use of self-curing admixture curing admixtures is very important from the point of view that the water resources are getting valuable every day. The benefit of self -curing admixtures is more significant in desert areas where water is not adequately available .In this study the mechanical properties of self-curing at different percentages of poly ethylene glycol will be evaluated and compared with conventional concrete specimen.

Scope of the study is to identify the effect of polyethylene glycol-400(PEG-400) on strength characteristics of self-curing concrete and also to evaluate influence of poly ethylene glycol-400 on mechanical properties which are experimentally investigated.

1.2 Objectives of Study

- To study the mechanical characteristic of concrete i.e., compressive strength by varying the percentage of PEG from 0% to 2.0% by weight of cement for M25 grade of concrete.
- To attain the optimum percentage of PEG required for curing of concrete.
- To study the fly ash behavior in self curing concrete up to 30% replacement by weight of cement.
- To compare the concrete mixes with and without self curing agent subjected to indoor curing and conventional curing respectively.

2. EXPERIMENTAL STUDY

2.1 Materials Used

A. Cement: OPC (53 grade) conforming to IS: 12269-1987

B. Fine aggregate conforming to IS: 383-1970: Locally available sand, free from silt and organic matters was used. The particle size of the sand used in this study was such a way that it passed through 4.75mm sieve conforming to zone III. The specific gravity was 2.73 and Fineness modulus was 2.59

C. Coarse aggregate: Crushed stones with 60% passing 20 mm and retained on 12.5mm sieve and 40% passing 12.5mm and retained on 4.75mm sieve were used. The weight of coarse aggregate was 60% of the total aggregate and specific gravity of coarse aggregate was 2.76

D. Fly ash was obtained from thermal power plant located at KUDITHINI BELLARY THERMAL POWER STATION and used in the investigation. The specific gravity is 2.20

E. Water: Potable water was used in the experimental work for both mixing and curing purposes.

F. Polyethylene Glycol-400(PEG-400) (Used as an internal curing compound): Polyethylene glycol is a condensation polymer of ethylene oxide and water with the general formula H(OCH2CH2)nOH, where n is the average number of repeating polyethylene groups typically from 4 to about 180. One common feature of PEG appears to be the water-soluble nature. Polyethylene glycol is non-toxic, odorless, neutral, lubricating, non-volatile and non-irritating and is used in a variety of pharmaceuticals. Thus, it is a shrinkage reducing admixture.

2.2 MIX PROPORTIONS

The conventional method used in the making of normal concrete is adopted in the current experimental investigation. First, the fine aggregate, coarse aggregate and fly ash is mixed in dry condition for 3- 4 minutes. The self curing admixture PEG-400 is added to the water, mixed thoroughly and then it is added to the dry mix. The mixing is done about 6-8 minutes for proper bonding of all the materials. After the mixing, the specimens are casted by giving proper compaction in three layers.

Table - 1.0: Material requirement for 1 Cu.mt

Materials (kg/m^3)	Mix Id		
	M1	M2	M3
Cement	405	360	315
Fly ash	45	90	135
Fine aggregates	665	633	600
Coarse aggregates	1085	1033	981
Water	186	186	186
Chemical Admixture	2.3 (0.5% PEG 400)		
	4.65 (1.0% PEG 400)		
	6.98 (1.5% PEG 400)		
	9.3 (2.0% PEG 400)		

Figure - 1.0 Casting of Concrete Cubes

Figure - 2.0 Casting of Concrete Cylinders

Figure - 3.0 Curing of Specimens

3.0 TEST RESULTS

The various strength tests that are to be done listed as below.

- Compressive Strength
- Split Tensile Strength

Table - 2.0: Details of Test Specimens.

Sl. No	Name of Test	Size of Specimen (mm)	Number of Specimen casted
1.	Compressive Strength (P/A)	100 x 100 x 100	117
2.	Split Tensile Strength (2P/πLD)	150 x 300	117
Total			234

3.1Compressive Strength Test:

Concrete cubes are tested in compressive testing machine (200 Tonne capacity) to determine their compressive strength of 3 specimens at the age of 14th, 28th and 56th days. From the test results, it was observed that the maximum compressive strength was obtained for mix M1 with 10% fly ash and 1% of PEG 400, M2 with 20% fly ash and 1% of PEG 400 and M3 with 30% fly ash and 1.5% of PEG 400.

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Figure - 4.0 Compressive test on concrete cube.

Table - 3.0 Experimental results of compressive strength of cube at 14 days of age in N/mm²

Mix Id	M1	M2	M3
PEG0.5	32.00	20.67	24.67
PEG1.0	34.00	28.67	29.33
PEG1.5	30.33	34.67	25.33
PEG2.0	27.67	33.33	29.00

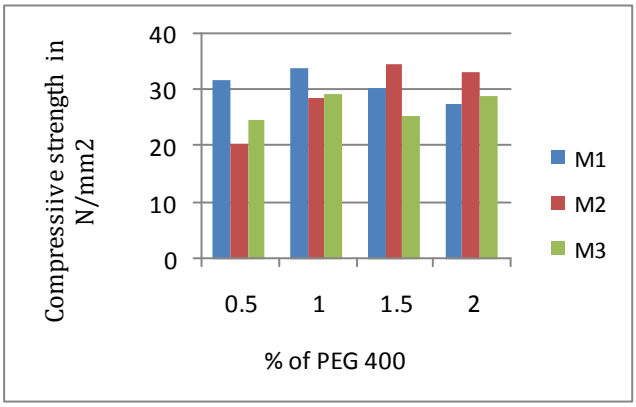

Chart -1: Cube compressive strength results at 14 days.

Table - 4.0 Experimental results of compressive strength of cube at 28 days of age in N/mm²

Mix Id	M1	M2	M3
PEG0.5	44.00	41.33	41.33
PEG1.0	50.00	40.00	40.00
PEG1.5	35.67	38.33	38.33
PEG2.0	40.67	39.67	39.67

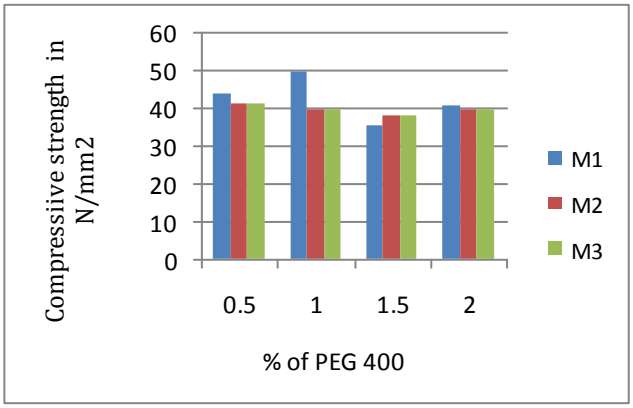

Chart -2: Cube compressive strength results at 28 days.

Table - 5.0 Experimental results of compressive strength of cube at 56 days of age in N/mm^2

Mix Id	M1	M2	M3
PEG0.5	45.67	42.33	41.67
PEG1.0	52.33	41.33	40.33
PEG1.5	38.33	39.00	43.33
PEG2.0	42.67	40.67	40.67

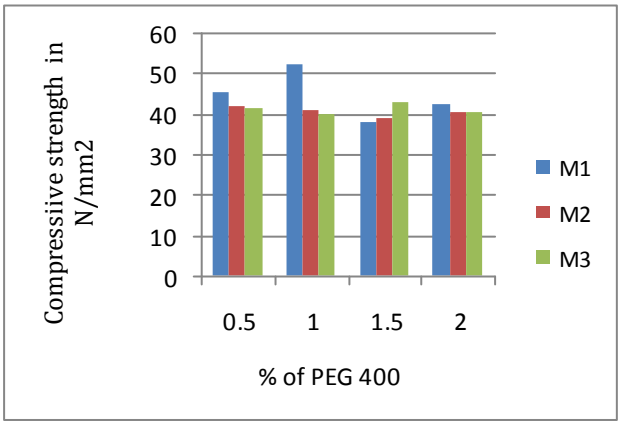

Chart -3: Cube compressive strength results at 56 days

3.2 Split Tensile Strength Test:

Tensile strength is one of the basic and important properties of concrete. Size of test sample of 15cm diameter, 30cm height cylindrical mould is used. The variation of split tensile strength at the age of 14, 28 and 56th days with optimum percentage of Fly ash and PEG 400 were given below. It was observed that the maximum split tensile strength was obtained M1 with 10% fly ash and 1% of PEG 400, M2 with 20% fly ash and 1% of PEG 400 and M3 with 30% fly ash and 1.5% of PEG 400.

Figure - 5.0 Split Tensile strength test

Table - 6.0 Split Tensile Strength results at 14 Days of age in N/mm^2.

Mix Id	M1	M2	M3
PEG0.5	3.30	2.78	3.06
PEG1.0	3.02	3.02	2.88
PEG1.5	2.88	2.83	2.83
PEG2.0	3.06	2.78	2.73

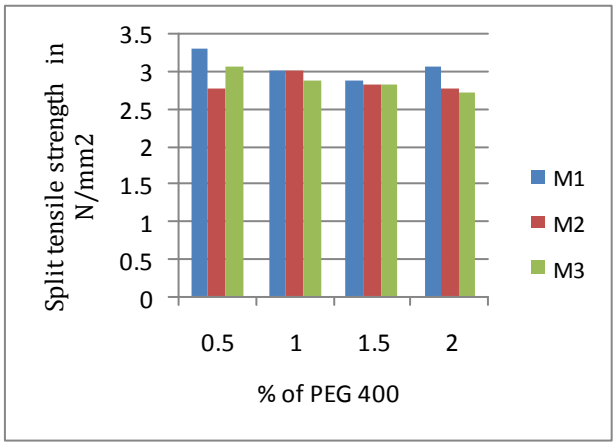

Chart -4: Split Tensile strength results at 14 days

Table - 7.0 Split Tensile Strength results at 28 Days of age in N/mm²

Mix Id	M1	M2	M3
PEG0.5	3.44	3.30	3.35
PEG1.0	3.63	3.25	3.35
PEG1.5	3.39	3.72	3.54
PEG2.0	2.92	3.30	3.11

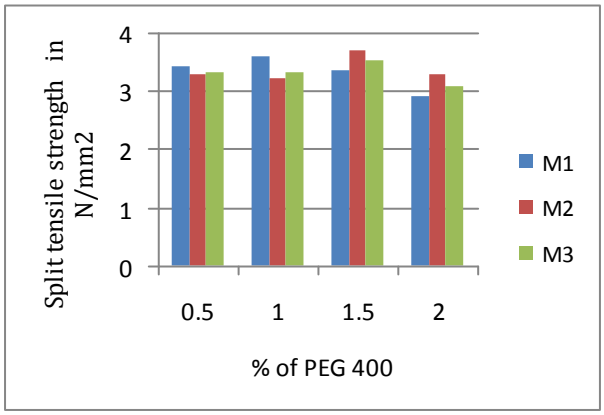

Chart -5: Split Tensile strength results at 28 days

Table - 8.0 Split Tensile Strength results at 56 Days of age in N/mm²

Mix Id	M1	M2	M3
PEG0.5	3.49	3.21	3.25
PEG1.0	3.72	3.35	3.44
PEG1.5	3.39	3.72	3.72
PEG2.0	3.11	3.25	3.16

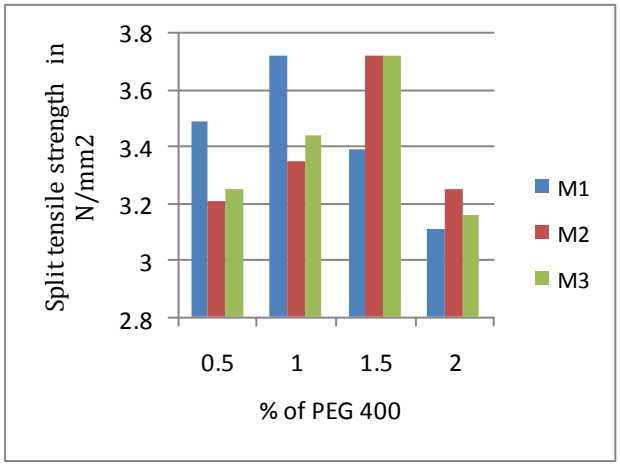

Chart -6: Split Tensile strength results at 56 days

4. CONCLUSIONS

Based on the results obtained in the experimental investigation, the following conclusions are drawn.

- When used in optimal values, the self curing agent provides astonishing results.
- Unnecessary increase of self curing agent causes in reduction of strength in concrete.
- Workability of concrete increases with the addition of self curing agent.
- As the strength properties of concrete vary from grade , optimal dosages can be determined by adopting many number of trials.

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