

Development of Conventional Concrete and Self Curing Concrete Using PEG 4000 and Comparison of Strength Characteristics

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ABSTRACT: Recently water is becoming a scanty material day-by-day, there is a serious need to do some research investigation work for saving the water in making of concrete. Curing of concrete is maintaining sufficient moisture content in concrete during its early stages because it plays a major role on strength and durability characteristics. However, enough curing is not always practically possible in many cases. So, keeping importance to this, an attempt has been made to develop self curing concrete by using Super Absorbing Polymers as self curing agents. Strength Characteristics of concrete containing self curing agent is investigated and compared with conventionally cured concrete. Polyethylene Glycol 4000 is used as self curing agent for this work. Self curing agent increases the water holding capacity of the concrete by diminishing evaporation of water from concrete..

KEYWORDS: Self Curing, Self Curing agent, Polyethylene Glycol 4000, Strength characteristics.

I. INTRODUCTION

Curing of concrete structures is very important to achieve required strength and durability requirements. In conventional curing, these requirements are achieved by external curing applied after the final setting of concrete. Self-curing is a technique that uses self curing agent which increases the water retention capacity of the concrete by diminishing the evaporation of water from concrete and which leads to a more effective hydration of cement and reduced self-desiccation.

Construction industries all over the world use a lot of water for the purpose of curing. Now a days the world facing serious water scarce issues, so we have to switch over to an alternative curing system called self curing and this technique is very useful in the areas where there is a water scarcity is a major problem.

The experimental program was designed to investigate the strength of self curing concrete by adding polyethylene glycol PEG4000 @ 0.5%, 1%, and 1.5% by weight of cement to the concrete. M30 grade of concrete is used for this entire study. The experimental program was aimed to study the workability, compressive strength, and Durability Test.

II. LITERATURE REVIEW

Manoj Kumar, D (2013) Studied on Self Curing concrete with the self curing agent as Super absorbent polymers. M40 grade of mix is used for his entire investigation. Water retention capacity of self cured concrete is higher than that of conventionally cured concrete and it was found by mass loss with time. The optimum % of SAP is 0.3%. Compressive strength and split tensile strength of self cured concrete with the optimum dosage is giving higher strength than that of conventional cured concrete. Flexural strength of self cured concrete is lower than that of conventionally cured concrete. He found that there was an increase in the strength for the dosage from 0.2 % to 0.3 % and later it minimized.

El-Dieb (2007) Studied water retention capacity of concrete using water-soluble polymeric glycol as self curing agent. Concrete weight loss with respect to time was carried out for finding out the water retention capacity of self cured concrete. Permeable voids percentage, water sorptivity, absorption percentage and water permeability tests are carried out for analysing the water transport through the concrete and the results are compared with the conventionally cured concrete.

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Sona K.S et.al (2014) , studied internal curing technique for effective hydration process. He studied the effect of variation in strength and durability characteristics were studied for different dosage of self curing agent and then he compared with the conventionally cured concrete. The optimum dosage of SAP for maximum strength characteristics was found to be 0.5% of weight of cement for M25 and M30. He conclude that self curing concrete is the good solution for water scarcity areas and desert regions.

Vedhasakthi K et.al (2014) studied the investigation on strength characteristics and workability of normal and high strength concrete, both are casted with self curing agents studied and compared with conventionally cured concrete. Design mix of M20, M30 and M40 were adopted. Super plasticizer dosage such as 0.8%, 1% and 1.2% of weight of cement were used for different grades of concrete respectively. The optimum dosage of PEG is 0.3% which has the significant increase in the strength.

Dahyabhai, et.al (2014) studied on Self curing in construction industry. Normally PEG 4000 is used as self curing agent but he used PEG 600 and PEG 1500 as self curing agent. The optimum dosage of PEG 600 is found to be 1% of weight of cement for M25 grade of concrete. The Optimum dosage of PEG 1500 is found to be 1% of weight of cement for M25 grade of concrete

III. MATERIALS USED

Polyethylene Glycol: Polyethylene glycol is a condensation polymer of ethylene oxide and water with the general formula $H(OCH_2C_2)_nOH$, where n is the average number of repeating oxyethylene groups typically from 4 to about 180. PEG is water-soluble in nature and it is a clear liquid.

Table 3.1 Properties of PEG 4000

S.No	Particulars	Values
1	Specific Gravity	1.12
2	Molecular Weight	4000
3	PH	7

Cement: Cement used in this study was 53 grade ordinary Portland cement conforming IS: 12269: 1987.

Table 3.2 Properties of Cement

S.No	Test Particulars	Values
1	Specific Gravity	3.15
2	Consistency	32
3	Initial setting time (mins)	40
4	Final setting time (mins)	590

Fine Aggregate: The fine aggregate used was obtained from our college campus. The fine aggregate conforming to zone III according to IS: 383-1970 was used for this study.

Table 3.3 Properties of Fine Aggregate

S.No	Particulars	Values
1	Specific Gravity	2.67
2	Grading Zone	III
3	Fineness Modulus	2.72
4	Type	River Sand
5	Total water absorption	1 %
6	Net water absorption	0.86 %

Coarse Aggregate: The coarse aggregate is according to IS: 383-1970 was used. Locally available aggregate from quarries in Tirunelveli were used in this study. Single size aggregate of 20 mm size was used for the entire study.

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Table 3.4 Properties of Coarse aggregate

S.No	Particulars	Values
1	Specific Gravity	2.76
2	Fineness Modulus	6.81
3	Type	Crushed
4	Water absorption	0.5 %
5	Moisture Content	Nil

Mix Design

Table 3.5 Mixproportions for various Dosages

Dosage (%)	Cement (Kg/m ³)	C.A (Kg/m ³)	F.A (Kg/m ³)	Chemical (Kg/m ³)
0	432.5	1080.57	728.50	0
0.5	362	1159.67	839.46	1.64
1	362	1157.66	837.90	3.29
1.5	362	1154.20	835.60	5.00

IV. METHODOLOGY

Compressive strength tests were carried out at the end of 7, 14 and 28 days for the concrete cube specimens of size 150 mm, using a Compression Testing Machine (CTM) as per IS: 516-1959. The compressive strength results presented in the report are an average of two readings.

Durability tests were carried out at the end of 14 days for the concrete cube specimens of size 150 mm, using a Compression Testing Machine (CTM).

Mass Loss tests were carried out at the end of 1, 7, 14 and 28 days for the concrete cube specimens of size 150mm, using a weighing machine.

V. EXPERIMENTAL INVESTIGATION AND RESULT ANALYSIS

Compressive Strength Test:

Totally we made 36 cubes for the Compressive Test. In that each 9 cubes are the addition of 0%, 0.5%, 1%, 1.5% of Polyethylene Glycol 4000. The results of compressive strength for different mixes were presented in table and graph

Table 5.1 Comparison of Compressive Strength for various dosages

Description	Strength (N/mm ²)		
	7 days	14 days	28 days
Conventional	24.88	37.77	38.22
PEG4000(0.5%)	28.44	38.93	40.24
PEG4000(1%)	24.88	30.75	37.33
PEG4000(1.5%)	17.77	27.55	36.08

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Graph for Comparison of Compressive Strength for various dosages of PEG 4000

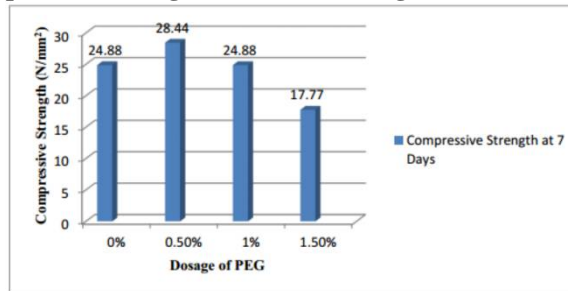


Fig. 5.1 Compressive Strength at 7 days

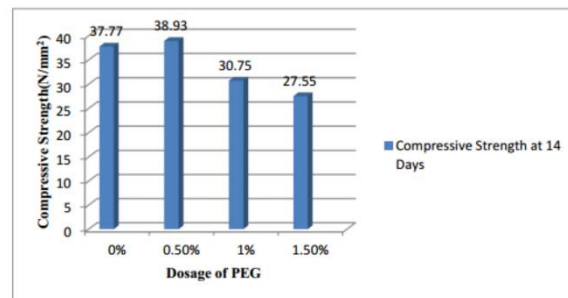


Fig. 5.2 Compressive Strength at 14 days

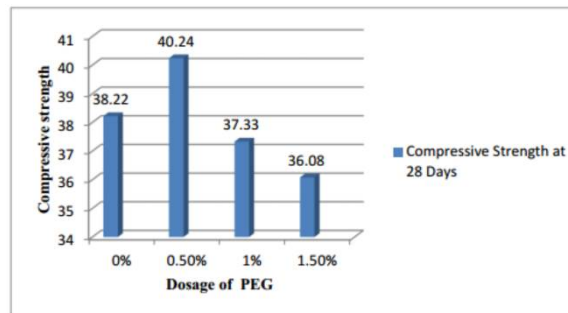


Fig. 5.3 Compressive Strength at 28 days

It was found that from the results the dosage of 0.5% of PEG 4000 has achieved more strength than conventional concrete at the end of 7, 14, 28 days. It was found from the graph, 0.5% of PEG is the optimum dosage for self-curing concrete.

Durability Test :

The Conventional concrete cubes as well as self-cured cubes (28 days Curing) were immersed in salty water. The percentage of salt used was 10% by weight of water. Cubes were cured in salty water for 14 days. After 14 days they were tested under Universal testing machine. The results found are to be shown in Table 5.2

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Table 5.2 Compressive strength after 14 days immersion in salty water

S. No	Description	Compressive Strength(N/mm ²)
1	Conventional	37.12
2	PEG4000(0.5%)	39.34
3	PEG4000(1%)	36.19
4	PEG4000(1.5%)	34.29

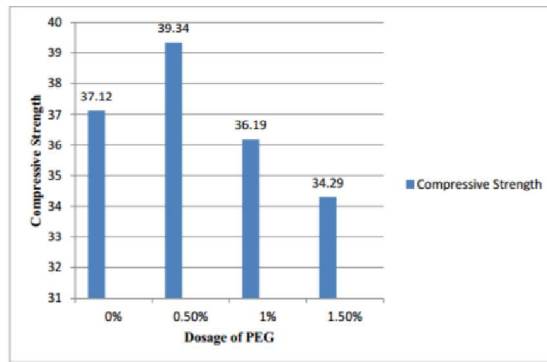


Fig. 5.4 Compressive strength after 14 days immersion in salty water

It was found from the graph, 0.5% of PEG gives good strength than conventional concrete in case of Durability.

Mass Loss Test :

Mass Loss tests were carried out at the end of 1, 7, 14 and 28 days for the concrete cube specimens of size 150mm, using a weighing machine.

Table 5.3 Mass Loss with respect to Time

Dosage of PEG 4000	Weight of Cubes (grams)		
	1 st day	14 th day	28 th day
Conventional	8800	8450	8108
PEG4000(0.5%)	8818	8610	8402
PEG4000(1%)	8810	8544	8298
PEG4000(1.5%)	8822	8486	8185

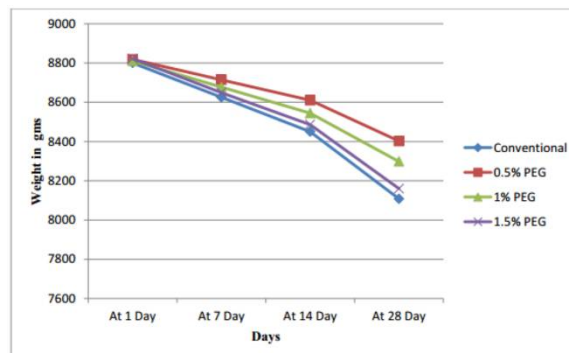


Fig. 5.4 Mass Loss with respect to Time

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VI. CONCLUSION

The following are the conclusions drawn from the above experimental investigation:

1. The optimum dosage of PEG4000 for maximum Compressivestrength was found to be 0.5% for grades of concrete.
2. Self-Curing can be applied to simple as well as complex shapes.
3. The self-curing agent Polyethylene Glycol was found to be more effective. Desired strength test results were obtained by using Polyethylene Glycol 4000 as Self curing agent.
4. From the compressive strength results, it was found that self-curing concrete has given more strength than that of conventionally cured concrete.
5. It was found that self-curing can be achieved in High Strength Concrete and there is significant increase in the strength of High Strength Self Curing Concrete than Conventionally Cured High Strength Concrete
6. Water retention capacity for the concrete mixes incorporating selfcuring agent is higher compared to conventional concrete mixes, as found by the weight loss with time.
7. Self-curing concrete resulted in better hydration with time under drying condition compared to conventional concrete.

REFERENCES

1. Stella Evangeline., Self-Curing Concrete and its Inherent properties, Stella Evangeline Int. Journal of Engineering Research and Applications ISSN : 2248-9622, Vol-4, Issue 8 (Version 7), August 2014, pp.66-71
2. Mohan Raj A, An Experimental investigation Of Eco-Friendly Self Curing Concrete incorporated with polyethylene glycol, ISSN 2393-8021, International Advanced research journal in Science, Engineering and Technology Vol. 1, Issue 2, October 2014
3. Vedhasakthi.K, Saravanan.M, Development of Normal Strength and High Strength Self Curing Concrete using Super absorbing Polymers (SAP) and Compression of Strength Characteristics, eISSN 2319-1163, International Journal of Research in Engineering and Technology
4. Nirav R Kholia, Effect on Concrete by Different Curing Method and Efficiency of Curing Compounds- A Review, eISSN 0976-3945, Kholia et al, International Journals of Advanced Engineering and Technology.
5. Neville, A.M., 1996, Properties of Concrete, Fourth and Final Edition, John Wiley and Sons, Inc., New York, USA.
6. ACI Committee 305R- "Hot eather Concreting", Reported by ACI Committee 305, ACI Manual of Concrete Practice, 2009.
7. M.V.Jagannadha Kumar, Strength Characteristics of self-curing concrete IJRET ,Vol: 1, Issue: 1, pp 51 -57, 2012 43
8. Nirav R Kholia, Prof. Binita A Vyas, Effect on concrete by different curing method and efficiency of curing compounds International Journal of Advanced Engineering Technology, pp: 57-60, 2013
9. Kovler, K ; et al , "Pre-soaked lightweight aggregates as additives for internal curing of high-strength concrete", Cement, Concrete and Aggregates, No 2, Dec. 2004, pp 131 -138.
10. Lura, P , "Autogenous Deformation and Internal Curing of Concrete," Ph.D. Thesis, Technical University Delft, Delft, The Netherlands, 2003.