Strength Characteristics of Self Curing Concrete Incorporating Polyethylene Glycol-400

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Abstract – The strength properties of concrete having self-curing agents as Polyethylene Glycol 400 are investigated in this paper. In this study self-curing agents is used with different amounts like 0%, 0.5%, 0.75%, 1%, 1.25%, and 1.5% by weight of cement. In this study the cement content of 320 kg/m3, water/cement ratio of 0.55 is maintained. After casting cubes are subjected to self-curing during experiment for 28 days and are tested on 7 day, 14 day and 28 day. The results experiment indicates that, the use of self-curing agents in concrete effectively improved the mechanical properties. The self-curing concrete having polyethylene-glycol as self-curing agent, attained higher values of compressive strength properties. It was found that 1% of PEG 400 by weight of cement was optimum for M20, without compromising workability.

Key Words: Self curing, Polyethylene Glycol-400

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1. INTRODUCTION

In order to achieve the designated self-curing concrete properties, water evaporation at the surface should be avoided in addition to supplying water from the exterior. If enough water is present in cement paste for the process of hydration the concrete will achieve proper strength. The traditional ways of curing often fail in practice. The concept of self-curing agents is to reduce the water evaporation from concrete, and hence increase the water retention capacity of the concrete compared to conventional concrete. It is also observed that use of polyethylene glycol will reduce early age cracking.

2. LITERATURE REVIEW

2.1 Self-curing concrete types; water retention and durability: Magda I. Mousa a,*, Mohamed G. Mahdy a, Ahmed H. Abdel-Reheem a, Akram Z. Yehia. This study was carried out to compare among concretes without or with silica fume (SF) along with chemical type of shrinkage reducing admixture, polyethylene-glycol (Ch), and leca as self-curing agents for water retention even at elevated temperature (50 C) and their durability. The cement content of 400 kg/m3, silica fume of 15% by weight of cement, polyethylene-glycol of 2% by weight Of cement, pre-saturated lightweight aggregate (leca) 15% by volume of sand and water with Ch/binder ratio of 0.4 were selected in this study.

2.2 Experimental investigation on the behavior of normal strength and high strength self-curing self-compacting concrete. M.M. Kamala, M.A. Safana, A.A. Bashandya, A.M. Khalilb. This research consists of two stages. The first stage conducted to investigate the effect of curing agent onthe main properties of normal-strength and high-strength self-compacted concrete to obtain self-curing self-compacting concrete. The main variables are; concrete grade, curing agent type, and dosage. The second stage was conducted to investigate the behavior of reinforced concrete beams cast using the suggested two concrete types. The results were driven in terms of initial cracking loads, ultimate loads, and crack patterns of testing beams. Results indicate that the both types used, normal-strength and high-strength self-curing

2.3 Self-curing concrete: Water retention, hydration and moisture transport. A.S. El-Dieb *

Water retention of concrete containing self-curing agents is investigated. Concrete weight loss, and internal relative humidity measurements with time were carried out, in order to evaluate the water retention of self-curing concrete. Non-evaporable water at different ages was measured to evaluate the

hydration. Water transport through concrete is evaluated by measuring absorption%, permeable voids%, water sorptivity, and water permeability. The water transport through self-curing concrete is evaluated with age. The effect of the concrete mix proportions on the performance of self-curing concrete were investigated, such as, cement content and w/c ratio.

2.4 An Experimental Investigation of Self Curing Concrete Incorporated with Polyethylene Glycol as Self Curing Agent: ShikhaTyagi introduced article which help to locate the ideal dose of PEG400 for maximum strength is observed to be 1% for M25 and 0.5% for M40 grade. The impact of PEG400 on workability is studies by taking slump cone and compaction factor tests. In this investigation the dosage of PEG400 has been fixed from 0% to 2%. The test outcomes were contemplated both for M25 and M40 grade. Conclusion cab be made with the help of this experiment that this self-curing agent help in self-curing and gives strength compare to conventional curing technique and furthermore enhanced workability.

2.5 Studies On Properties Of Self-Curing Concrete Using Poly-Ethylene Glycol: Basil M Joseph conclude in the paper that percentage of self-curing admixture that is PEG400 is giving maximum compressive strength, maximum modulus of rapture and tensile strength. It was observed that when the percentage of PEG400 exceeds 1% strength is reduced slightly. As a alternative instead of conventional curing in concrete, we use self-curing method for concreting it will be really helpful in desert area where water availability is less. The purpose of this examination was to assess the utilization of water-solvent polymeric glycol which act as a self-curing agent. Utilization of admixture of self-curing is essential from the perspective that the water is getting important consistently. As 1m3 of concrete require 3m3 of water for curing

3. RESEARCH SIGNIFICANCE

In order to eliminate the usage of water to cure the concrete here is an attempt of self-curing by using Polyethylene glycol (PEG 400) in concrete mix by varying percentages with respect to the weight of cement for M20 grade of concrete. And also to study the effects of using this PEG 400 on strength characteristics. When the mineral admixtures react completely in a blended cement system, their demand for curing water which may be external or internal can be much greater than that in a conventional ordinary Portland cement concrete. When this water is not readily available early-age cracking may result. Due to the chemical shrinkage occurring during cement hydration, empty pores are created within the cement paste, leading to a reduction in its internal relative humidity and also to shrinkage which may cause early-age cracking

4. MATERIALS

Various materials used in this investigation are as follows:

Cement: Ordinary Portland Cement OPC 43 grade confirming to IS: 12269 were used and its specific gravity is 3.15.

A. Fine Aggregate: River sand having 10mm and 20mm size. The specific gravity of 10mm sand is 2.88 and specific gravity of 20mm size is 2.89 confirming to IS 383-1970.

B. Coarse Aggregate: Crushed aggregates confirming to IS 383-1970. Which is available from a local quarry and the specific gravity is 2.79.

C. Polyethylene Glycol 400: Polyethylene is a polyether compound obtained by the condensation of polymer of ethylene oxide and water. Its Chemical formula is H-(O-CH2-CH2)n-OH.

Table1. Properties of Polyethylene Glycol-400

Sr. No.	Property	Value
1	Appearance	Clear liquid
2	Odour	Nil
3	Sp. gravity	1.09
4	pH	5-7
5	Molecular Weight	400
6	Density	1.128 g/cm3

5. EXPERIMENTAL PROGRAMME

In the recent research study total numbers of 54 cubes were casted in the standard dimension 150 x 150 x150 mm. To fix the optimum dosage of PEG 400 usage cubes were casted by varying percentages starting from 0%, 0.5%, 0.75, 1.0%, 1.25% and 1.5% with respect to the weight of the cement content used andwater/cement ratio of 0.55 is maintained.After casting cubes are subjected to self-curing during experiment for 28 days and are tested on 7 day, 14 day and 28 day to obtain Compressive strength.

Table2. Mix proportion of concrete

Sample	Cement (kg/m^3)	W/C	Polyethylene Glycol% (PEG)
1	320	0.55	0
2	320	0.55	0.50
3	320	0.55	0.75
4	320	0.55	1.00
5	320	0.55	1.25
6	320	0.55	1.50

6. TESTING

6.1 Slump Test and Compaction Factor

For measurement of workability of concrete Slump and compacting factor tests are used. The results obtained are discussed as follows:

Table3. Results of Slump cone test and Compaction factor test.

Sr. No	PEG 400	Slump (mm)	Compaction Factor
		M20	M20
1	Plain	80	0.88
2	0.50%	92	0.90
3	0.75%	112	0.91
4	1.00%	121	0.93
5	1.25%	140	0.96
6	1.50%	174	0.97

6.2 Compressive strength

The cube specimens were tested on compression testing machine of capacity 3000KN.The bearing surface of machine was wiped off clean and sand or other material removed from the surface of the specimen. The specimen was placed in machine in such a manner that the load was applied to opposite sides of the cubes as casted that is, not top and bottom. The axis of the specimen was carefully aligned at the center of loading frame. The load applied was increased continuously at a constant rate until the resistance of the specimen to the increasing load breaks down and no longer can be sustained. The maximum load applied on specimen was recorded.

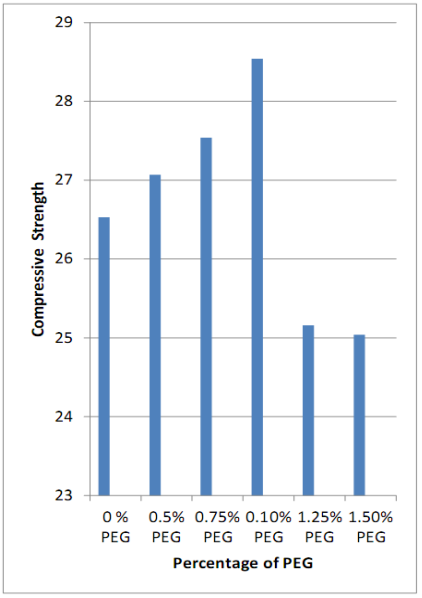
fc = P/A, where, P is load & A is area in mm2

7. RESULTS AND DISCUSSIONS

Test results of the compression strength are shown in table 4. And graph 1. As shown in table 4 and graph 1, compressive strength developed in every case of concrete containing Polyethylene Glycol-400 is higher than the normal concrete specimen (concrete without PEG-400). It is also indicated that, compressive strength of concrete specimen increases from 0.5% to 1% addition of PEG-400 in concrete specimen and after 1% it decreases. Addition of PEG1% by wt. of cement in concrete results, maximum increase in compressive strength 7.57% as compared to normal concrete.

Table 4. Compressive strength of specimens after 28 days

Specimen	Compressive strength (MPa)	% increase or decrease in compressive strength
1	26.53	1
2	27.07	1.02
3	27.54	1.04
4	28.54	1.08
5	25.16	0.95
6	25.04	0.94



Graph.1 Compressive strength of specimen

8. CONCLUSION

Compressive strength of concrete specimen containing 0%,0.5%, 0.75%,1%,1.25 and 1.50% of Polyethylene Glycol-400particles were investigated. From 0% up to 1% strength increases linearly. Samples containing 1% PEG, shows better compressive strength properties than normal concrete. Increasing more than 1% by wt. of cement, reduces the compressive strength of concrete.

Self-curing concrete is the answer to many problems faced due to lack of proper curing without affecting to strength of concrete.

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