International Journal of Combined Research & Development (IJCRD)
eISSN:2321-225X;pISSN:2321-2241 Volume: 5; Issue: 8; August -2016

PEG (POLY ETHYLENE GLYCOL) AS AN INTERNAL CURING AGENT IN ORDINARY CONCRETE

D.Bala Tripura Sundari[1], V. Manikanta [2] ,L.Aparna[3]

[1] PG Scholar, Dept of Structural Engineering, Aurora's Technological and Research Institute, Parvathapur, Uppal, Hyderabad, TS, India.

[2]PG scholar, Dept. of Transportation Engineering, St' Mary Integrated campus, Batasingaram, Hyderabad, TS, India

[3]Assistant professor, Dept. of Structural Engineering, Aurora technological and Research Institute, Parvathapur, Uppal, Hyderabad, TS, India.

Abstract: Curing of concrete plays an important role maintaining the moisture content in concrete during its early stages of the concrete in order to achieve the desired properties. Improper curing leads to the strength degradation and affects the durability of the concrete very easily. Properly cured concrete has better durability properties.The prevention of the moisture from the concrete plays an important role not in only in the strength point but also it helps in reduction of the shrinkage and permeability. Here the internal curing (or) self-curing plays a critical role in solving these problems. The main aim of the self-curing agent is to reduce the evaporation of water from the concrete. The water evaporation can be reduced by the self-curing agent (Polymeric Glycol) and increase the water retention capacity. The Hydrophilic material (Polymeric glycol)act as a self-curing compound. The present investigation aimed to check the role of polymeric Glycol and compare with different curing regimes. The main parameters considered in this study is to grade of concrete (M30), dosage of polyethylene glycol and age of curing. Weight loss and compressive strength was determined as a performance of the self-curing agent.

Key words: Hydrophilic compound, Poly ethylene Glycol, Water retention, compressive strength, Internal sealing.

1. INTRODUCTION:

If water is to be purchased for construction works, the cost of construction goes much higher. Also, the concreting works done at heights, vertical members, sloped roofs and pavements, continuous curing is very difficult. Where thickness of concreting is larger, the percolation of water in the concrete, especially in case of high strength concrete is difficult. In the case of High Performance Concrete / Self Compacting Concrete, where the surface pores and mixing water are minimized, complete curing of cement particles does not take place.

Internal curing is especially beneficial in low water cement ratio (w/c) concretes because of the chemical shrinkage that accompanies Portland cement hydration and the low permeability of the calcium silicate hydrates. Because the water that is chemically bound and absorbed by the cement hydration products has a specific volume less than that of bulk water, a hydrating cement paste will imbibe water from an available source. While in higher w/c concretes, this water can be and often is supplied by external curing, in low w/c concretes; the permeability of the concrete quickly becomes too low to allow the effective transfer of water from the external surface to the concrete interior. This is one

of the justifications for internal curing. Additional water that can be distributed somewhat uniformly throughout the concrete will be more readily able to reach un-hydrated cement. This can be achieved by using presoaked Light Weight

Specifications of PEG 4000

S.No.	SPECIFICATION	PEG 4000
1	molecular weight	3500-4500
2	appearance	white flake
3	colour	10 max
4	moisture	0.1% max
5	hydroxyl value	25 - 35 (mg KOH/g)
6	ph	5 – 7
7	specific gravity	1.08 - 1.09
8	dioxane	1ppm max

2.MIX DESIGN FOR MIX-A

In this study, mix design is done by two methods

i)IS Code
ii)ACI
In order to obtain strength around 30MPa. Number of trails were conducted to obtain the desired strength and to maintain good workability (slump of about 100mm) and finally acquired a mix proportion (1:1.4:2.6) (C: FA: CA) with w/c ratio of 0.47. To obtain good workability and desired strength the optimum water-cement ratio kept at 0.35 and super-plasticizer is to be used in the mix.

2.1 Test for Concrete

2.1.1 Slump Test

Slump test is the most commonly used method of measuring workability of concrete. It is not a suitable method for very wet or very dry concrete. It does not measure all factor contributing to workability.

2.1.2 Compacting Factor Test

It is more precise and sensitive than the slump test and is particularly useful for concrete mixes of very low workability as are normally used when concrete is to be compacted by vibration. Such dry concrete are insensitive to slump test.
This test works on the principle of determining the degree of compaction achieved by a standard amount of work done by allowing the concrete to fall through a standard height. The degree of compaction, called the compacting factor is measured by the density ratio *i.e.* the ratio of the density actually achieved in the test to density of same concrete fully compacted.

2.1.3 Water Retentivity Test
Water Retentivity is the ability of the substance to retain water.

To perform the water retentivity test, the cubes were weighed for every 3 days from the date of casting. Weight loss for the specimens in indoor curing, and weight gain for the conventional curing are noted and their behavior is plotted in graph against number of days of curing.

3.MATERIALS USED

3.1 Materials used:
The different materials used in this investigation are

3.1.1. Cement: Cement used in the investigation was 53 Grade Ordinary Portland cement confirming to IS: 12269. The specific gravity of cement was 3.14 and specific surface area was 225 m^2/g having initial and final setting times of 40 min and 560 min respectively.

3.1.2. Fine Aggregate: The fine aggregate was conforming to Zone-2 according to IS: 383. The fine aggregate used was obtained from a nearby river source.

3.1.3. Coarse Aggregate: Crushed granite was used as coarse aggregate. The coarse aggregate was obtained from a local crushing unit having 20mm nominal size, well graded aggregate according to IS: 383.

3.1.4. Water: Potable water was used in the experimental work for both mixing and curing companion specimens.

3.1.5Super plasticizer (SP): Sulphated Naphthalene formaldehyde based super plasticizer is used for improvement of workability.

4. TESTS ON CONCRETE

4.1 Compressive Strength of Concrete:
The compression test was conducted according to IS 516-1959. The compressive strength was obtained after 7 and 28 days of curing. Standard cast iron moulds of dimensions 150x150x150mm were used to cast the specimen.

4.2 Split tensile Strength of Concrete:
The split tensile test is conducted according to IS 516-1959.The split tensile strength was obtained after 7 and 28 days of curing. Standard cast iron moulds of dimensions 150 mm diameter and 300 mm height is used to cast the specimens.

4.3 Flexural Strength of concrete:

The flexural test is conducted according to IS 516-1959.The flexural strength was obtained after 7 and 28 days of curing. Standard cast iron moulds of dimensions 100x100x500 mm is used to cast the specimens.

5.RESULTS & DISSCUSSIONS

As per Experimental programme results for different experiments were obtained. They are shown in table format or graph, which is to be presented in this chapter.

5.1. Compressive Strength Result:
As per the **Table 5.1** and **Fig.5.1** the following are the observations on compressive strength of concrete for self curing, indoor curing and wet curing.

i. The compressive strength of Mix AOW- 0% dosage of S.C.A is more when compared to other dosages.

ii. The compressive strength of Mix AH-1% dosage of S.C.A is more when compared with other dosages of PEG-4000.
iii. Mix AH-1% dosage of S.C.A has shown better strength than other self curing compound and also other dosages of PEG-4000.
iv. From over all observation the values of compressive strength, it is noticed that Mix AH-1% dosage of S.C.A is beneficial when there is no possibility of water curing.

Table 5.1 Compressive Strength of Concrete in N/mm^2 for Mix A Different dosage of PEG 4000

SPECIMEN NAME	7 DAYS CURING	28 DAYS CURING
AOW	22.54	38.45
AOI	17.67	28.98
AH-0.1%	19.32	30.65
AH-0.5%	20.45	32.098
AH-1%	22.23	37.24
AH-1.2%	19.57	32.86

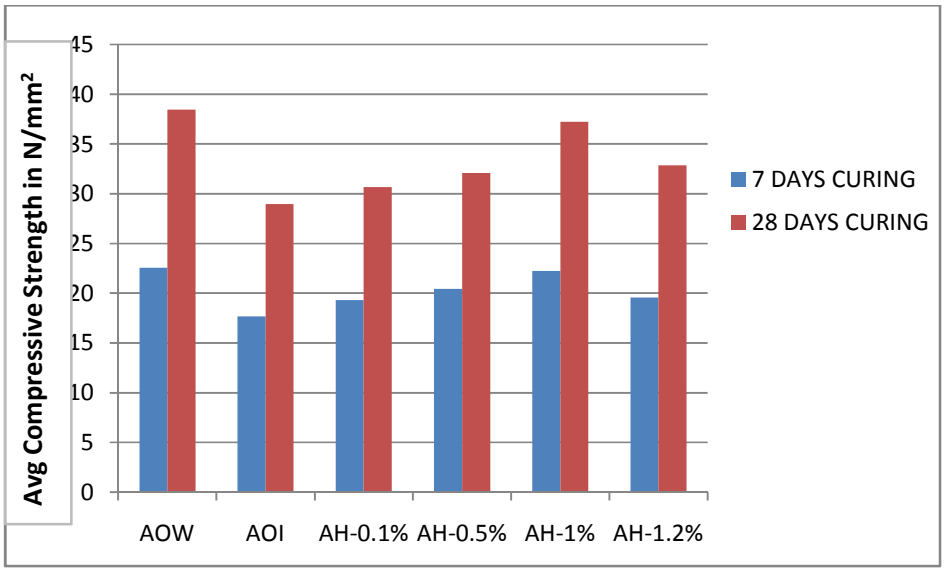


Fig 5.1 compressive strength of Concrete for Mix A with PEG-4000

5.2 Split Tensile Strength And Flexural Strength Test Results:

It is necessary to determine the split and flexural strength of concrete to known the mechanical properties of self curing concrete with different self curing compounds like liquid paraffin wax and polyethylene glycol. The following are the observations of split tensile and flexural strength test results it is cleared from the results that the optimum dosage of self curing is Mix AH-1% i.e PEG-4000 when compared with other self curing agent and also other dosages.

Table 5.2 Split Tensile and flexural strength of Concrete after 28 days curing in N/mm^2

SPECIMEN NAME	SPLIT TENSILE STRENGTH IN N/mm^2	FLEXURAL STRENGTH in N/mm^2
AOW	3.14	3.84
AOI	1.88	2.76
AH-0.1%	2.27	3.09
AH-0.5%	2.56	3.35
AH-1%	3.05	3.72
AH-1.2%	2.12	3.01

5.3Compaction Factor Test

The compaction test is performed to calculate the compaction factor, and to know more about workability. The values of the compaction factor for different dosage of PEG, is observed that in Mix A the compaction factor is increased with increase of % of PEG 4000

Table 5.3 Compaction factor for the Different Percentage of PEG

Percentage Dosage of SCA	0.1	0.5	1	1.2
AH	0.962	0.975	0.985	0.992

5.4 . Water Retentivity Test Results for MIX A:

Concrete with high molecular weight PEG and Liquid paraffin wax subjected to indoor curing was studied by weighing the samples at regular intervals of 3 days, with digital weighing machine of accuracy 5 gm up to 28 days.

i)It is clearly observed that the specimen without S.C.A of Mix AOI is losing more weight when compared to specimens with dosage of 0.1%, 0.5, 1 and 1.2% of S.C.A.

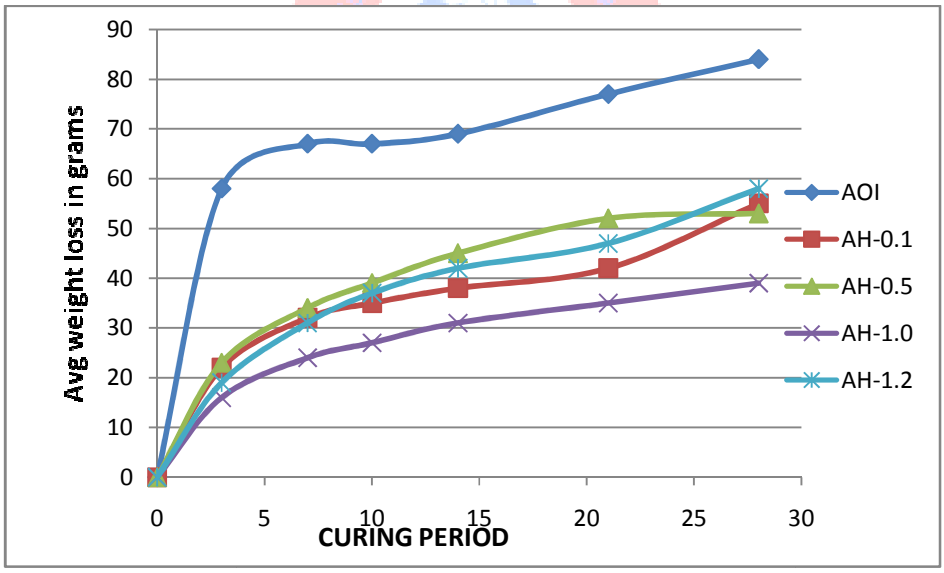
ii)It is clearly observed that the specimen with S.C.A of Mix AH-1% dosage the weight loss is less compared to other dosages (0%,0.5%,1% and 1.2%) .

iii)Over all it is clear that the optimum dosage of S.C.A based on the water retentivity test is AH-1% i.e PEG-4000 of dosage 1% is the best of all other curing agents and dosages.

Table 5.4 Avg. Weight Loss (KG) for Mix A for the Different Percentage of PEG 4000

Nomenclature of Mix	0	3	7	10	14	20	28
A0I	0	0.058	0.067	0.067	0.069	0.077	0.084
AH 0.1	0	0.022	0.032	0.035	0.038	0.042	0.055
AH 0.5	0	0.023	0.034	0.039	0.045	0.052	.0.053
AH 1	0	0.016	0.024	0.027	0.031	0.035	0.039
AH 1.2	0	0.019	0.031	0.037	0.042	0.047	0.058

Fig 5.4 Avg. Weight Loss for Mix A for the Different Percentage of PEG -4000



6.CONCLUSIONS

Self curing concrete containing Ordinary Portland Cement with 0% dosage (by weight of cement) has maximum weight loss when compared to the other dosages.Self curing concrete containing Ordinary Portland Cement with Polyethylene glycol in indoor curing with 1% dosage (by weight of cement) has minimum weight loss when compared to the other dosages. Compressive strength of concrete with 1% dosage of PEG-4000 in indoor self cured is higher when compared with other self curing

compounds and also other dosages.The optimum dosage of self curing concrete for M_{30} grade of concrete is PEG of higher molecular weight with 1% dosage to the weight of cement.

7. REFERENCES

1.Wen-Chen Jau"Self-curing Concrete", United States Patent Application Publication, Pub. No: U.S. 2008/0072799 A1, Pub. date: Mar. 27, 2008.

2.Roland Tak Yong Liang, Robert Keith Sun, "Compositions and Methods for Curing Concrete", Patent No.: US 6,468,344 B1, Date of Patent Oct. 22, 2002.

3.A.S.El-Dieb, "Self-curing Concrete: Water Retention, hydration and moisture transport", Construction and Building Materials Vol.21 (2007) 1282-1287.

4.A.S. El-Dieb, T.A. El-Maaddawy and A.A.M. Mahmoud,"Water-Soluble Polymers as Self-Curing Agent in Silica Fume Portland Cement Mixes", ACI Material JournalVol.278 (2011) 1-18.

5.M. Collepardi, A. Borsoi, S. Collepardi, R. Troli and M. Valente ,"Self-Curing, Shrinkage-Free Concrete ",ACI MaterialJournal SP 234-47 (2006) 755-764.

6.R.K. Dhir, P.C. Hewlett and T.D. Dyer, "An investigation into the feasibility of formulating ' self-cure' concrete", Materials and StructuresVol.27(1994), 606-615.

7.Raghavendra Y.B and Aswath M.U,"Experimental investigation on concrete cured with various curing Methods-A Comparative Study",International Journal of Advanced Scientific Research and Technology, Issue: 2, Vol.3 (2012) 577-584.

8.Jagannadha Kumar M.V, Srikanth M, Rao K.Jagannadha,"Strength Characteristics of Self-curing Concrete", International Journal of Research in Engineering & Technology,Issue:1,Vol.1(2012) 51-57.

9.Ambily,P.S and Rajamane N.P, "Self-curing Concrete an Introduction", Structural Engineering Research Centre, CSIR, Chennai.

10.Text book on " Concrete Technology- "Theory and Practice" by M.S.SHETTY