Experimental Study on Self Curing Concrete

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Abstract— We are going to see how the water used in the curing purpose in construction can be neglected or reduced through this experiment. As we know that approx. 70 % water is available on our earth, out of which only 3 % water is potable. Only potable water is used in construction industry. In construction industry, water is a key ingredient that is used. Water is used in concrete because it binds other ingredients and also used in curing, which is necessary for concrete to survive. No fluid can be found that can make concrete without water so far. We are also seeing that concrete attains strength and durability through curing, otherwise concrete becomes contracted and will lose its strength as well. The water having pH ranges from 6-8, used for curing. Curing is essential because there is a lack of water in the internal hydration process of concrete. Therefore, we should mix something so that there is no lack of water in its internal hydration while making concrete. We have added Polyvinyl Alcohol (PVA) as a super absorbent polymer to overcome water scarcity in hydration of concrete. By adding different proportions of PVA, we test the concrete for their compressive, flexural, split tensile strength etc. The concrete which do not require external curing are called Self-Curing of Concrete.

Keywords: Potable Water, Fluid, Self-Curing Of Concrete, Strength and Durability of Concrete, Polyvinyl Alcohol (PVA), Flexural Strength, Split Tensile Strength

I. INTRODUCTION

Self-curing of concrete is a method that can be used to provide additional moisture in concrete for happening the hydration of cement effectively. There are many places where there is not enough water, there is a self-curing concrete in the construction. Curing plays a vital role in the growth of concrete properties throughout construction. Self-curing adds such admixtures to concrete that it completes its internal hydration process with an emphasis on atmospheric moisturization. The several advantages of self-curing are, heightened hydration process, strength development, reduced permeability and reduced autogenous shrinkage etc. In this experiment, we have used Polyvinyl Alcohol (PVA) as the self-curing admixture. PVA is added by different proportions (0.05%, 0.10%, 0.15%, 0.20%, 0.25% & 0.30% by weight of cement) in preparation of concrete. After adding PVA in different proportions, it was tested and it was found that it is better in comparison to conventional ordinary concrete. This experiment has been done on M25 grade of concrete. Later on in this experiment, we also saw that the weight of concrete has also declined.

The procedure of the admixture which is mix in self-curing concrete is that it continuously makes the appraisal of the moisture from the outer surface. PVA forms hydrogen bonds from other materials, reducing the chemical potential of the molecules. Physical moisture retention also occurs. During chemical shrinkage in cement hydration, the cement paste sometimes has empty space due to which its internal relative humidity is reduced and then contracted, resulting in cracks. Self-curing concrete cannot only be made from PVA, it can also be made from Poly-ethylene glycol (PEG).

II. MECHANISM OF SELF-CURING CONCRETE

Chemical agents are available in self-curing concrete that reduces the evaporation of water from the concrete surface frequently by reducing the vapour pressure. Self-curing agents that are added to the concrete mix form hydrogen bonds with the water molecules and reduce the chemical potential of the molecules thereby, reducing the vapour pressure and ultimately the rate of evaporation. The compound molecules are firstly hydrophobic in nature with hydrophilic terminal group. Hydrophilic terminal group is automatically attached to the film of bleeding water. While the long hydrophobic chain carry on a vertical orientation aside from the bleeding water. Water molecules do not have enough energy to go out through the hydrophobic layer. This process caused a sudden drop in evaporation loss.

A hydrophobic molecule is one that has a proportion to comprise with or dissolved by water. The hydrogen bond are partially redevelop by building water ‘cage' around the compound molecules, the water molecules that form the ‘cage' have considerably restricted mobilities.

III. OBJECTIVE OF THE STUDY

- Reduction in water used in curing.
- To study the effect of polyvinyl alcohol on concrete strength when used in different proportions.
- To solidify the loss in weight of the concrete.
- To state the short term resistance to acid.
- To prevent the shrinkage of concrete by providing available atmospheric moisture to it.

IV. LITERATURE REVIEW

K. Nithya, K. Ranjitha, P. Kumar studied show that the maximum compressive strength, split tensile strength and flexural strength was 33.7 MPa, 4.945 MPa and 8 MPa for 28 days when tested for M30 grade of concrete. Their experiment used different super absorbent polymer for making self-curing concrete. According to study, the best amount of PVA for utmost compressive strength was at 0.5 % for M30 grade of concrete.

C Soorya Tharshini, B. Belciya Mary studied show that by adding poly ethylene glycol PEG400 of different proportions by weight of cement in M20 and M40 grade of concrete. The experiment is to study workability, compressive strength and other various strength parameters.

V. PROPERTIES OF MATERIALS

A. Polyvinyl Alcohol (PVA) as Self-Curing Agent:

PVA is a water-soluble synthetic polymer. It is colorless and odorless. Its density ranges from 1.19 - 1.31 g/cm3. Flash point of PVA is 790 C. PVA is made by poly vinyl acetate. It works to keep water in concrete. Typically, a 5% solution of polyvinyl alcohol exhibits a pH in the range of 5.0 to 6.5. Polyvinyl alcohol has a melting point of 180 to 1900 C.

B. Specific Gravity of Aggregate:

IS: 383-1970 (part III) gives various methods to find specific gravity of aggregate. In this experiment specific gravity is found by using pycnometer method.

Specific gravity of natural sand is found to be 2.65

Specific gravity of coarse aggregate is found to be 2.80

C. Fineness Modulus:

Fineness modulus of natural sand is found to be 2.60
Fineness modulus of coarse aggregate is found to be 7.85

D. Cement:

Ordinary Portland Cement (OPC) of 53 grades was used. The properties of OPC used are shown in table 1.

SI No.	Property	Value
	Normal Consistency	27 %
	Initial Setting Time, Minutes	34
	Final Setting Time, Minutes	350
	Fineness	8.5 %
	Specific Gravity	3.15

Table 1

VI. EXPERIMENTAL STUDY CONDUCTED:

A. Mix Design:

The mix design is carried out according to IS: 10262-2009 for the mix of M25 grade of concrete.

w/c ratio	Water	Cement	Fine aggregate	Coarse aggregate
0.50	191	382	692	1193

Table 2: Mix Proportion (kg/m3)

The polyvinyl alcohol (PVA) was added at 0.0, 0.05, 0.10, 0.15, 0.20, 0.25 and 0.30 % by weight of the cement and tested for fresh properties of concrete and hardened properties of M25 concrete specimens.

After 28 days of concrete (without doing external curing) the specimens were dipped in 5 % hydrochloric acid solution. After that reshuffle the specimens from the solution and put the specimen in flowing water to remove the damage products and materials. After that dry the surface of the specimen and perform the strength tests.

VII. RESULT AND DISCUSSIONS:

A. Compressive Strength Test:

After 28 days, the compressive strength test was performed on compression testing machine. The result found is shown in table 3.

SI No.	Types of Concrete	Compressive Strength (MPa)
I.	Conventional Concrete Cubes	29.89
	Self-Curing Concrete Cubes (%PVA)	
II.	0.05	25.40
III.	0.10	27.24
IV.	0.15	28.91
V.	0.20	31.53
VI.	0.25	33.15
VII.	0.30	32.72

Table 3

B. Split Tensile Strength Test:

The split tensile strength of various proportions of PVA and compared with conventional concrete. Table 4 shows the results of split tensile strength test.

SI No.	Types of Concrete	Split Tensile Strength (MPa)
I.	Conventionally Cured Concrete	3.88
	Self-Curing Concrete (%PVA)	
II.	0.05	3.52
III.	0.10	3.60
IV.	0.15	4.25
V.	0.20	3.93
VI.	0.25	4.50
VII.	0.30	4.61

Table 4

C. Flexural Strength Test:

The variation of the flexural strength for various mixes with different % of PVA is shown in table 5.

SI No.	Types of concrete	Flexural Strength (MPa)
I.	Conventionally Cured Concrete	5.63
	Self-Curing Concrete (%PVA)	
II.	0.05	5.18
III.	0.10	5.94
IV.	0.15	6.58
V.	0.20	6.18
VI.	0.25	6.73
VII.	0.30	7.15

Table 5

VIII. CONCLUSION:

The conclusions of this study are as follows:-

- Through this study that with the help of PVA in concrete, work can be done without external curing which can save a lot of water.
- By adding the self-curing admixtures, the concrete attained more compressive strength.
- In desert areas, where there is scarcity of water, self-curing concrete is the best alternate than ordinary concrete.

- The optimal amount of PVA for adequate strength properties was found on 0.25 % for M25 grade of concrete.
- There is an increase in compressive strength of 10.9 % for M25 grade of self-cured concrete when compared with M25 conventional cured concrete.
- There is an increase in tensile strength of 15.9 % for M25 grade of self-cured concrete when compared with M25 conventional cured concrete.

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