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EVALUATION OF PROPERTIES OF SELF CURING CONCRETE BY USING POLYVINYL ALCOHOL

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ABSTRACT

The experimental study is carried out to examine the use of water-soluble and water retains by using polyvinyl alcohol PVA as self-curing agent. In the present work strength characteristics of self-curing concrete is to be better found and compared with conventional concrete of similar mix design.

The concrete properties are studied at different percentages of polyvinyl alcohol additional to the concrete mix by mass of cement i.e., starting from 0.03% and doubling the same. Locally available coarse aggregate having the maximum size of 16 mm and 10 mm was used in this work. The concrete mix is prepared by mixing the ingredients are cement, fine aggregate, coarse aggregate and PVA as per mix proportion. The Ingredients are weighed according to the mix proportion $M_{60.}$

The three specimens were tested for 3, 7 and 28 days with each proportion of PVA. The results which indicate that Water retention for the concrete mixes incorporate self-curing agent is elevated compared to conventional concrete mixes, as found by the mass loss with time. The result which shows that the compressive strength and workability of self curing concrete is found to be more than conventional concrete at certain percentage of Polyvinyl Alcohol [2] added to the concrete mix.

Keywords: Polyvinyl Alcohol, Self Curing agent, Water retentivity

I. INTRODUCTION

Curing of concrete is in favour of maintaining adequate moisture content in concrete for the duration of its early stages to build up the required properties [1]. But, good curing is not always realistic and often disused in several cases. The idea of self-curing agents is to decrease the water evaporation from concrete and hence raise the water preservation capacity of the concrete which is compared to conventional concrete.

The make use of self-curing admixtures is very significant from the point of sight that water resources are reaching precious every day. The advantage of self-curing admixtures is more considerable in wasteland areas anywhere water is not sufficiently obtainable.

Curing is the mainly significant movement in concrete structure. Lack of curing has considerable impact on concrete strength and durability. Hydrophilic water--soluble polymers which can be used as self--curing agents in concrete as they can absorb water and keep the surrounding medium moist so that water can be used later by cement.

Curing is planned first and foremost to keep the concrete wet, by prevent the loss of moisture from the concrete during the period in which it is gaining strength. The two specimens such as cylinder and beams are tested by using Split tensile and flexural tests to find their strengths.

II. PROPERTIES OF MATERIAL

2.1 Polyvinyl alcohol as self curing agent

Polyvinyl alcohol is formed from the chemical compound of polyvinyl acetate, regularly by a continues process [5]. It is clear and white coloured granular powder. It melts in hot water and soluble in ethyl alcohol, PH ranges of a 5% solution of polyvinyl alcohol exhibits 5.0 to 6.5. It has properties like emulsifying and gum properties.PVA is fully degradable and dissolves quickly [7].

2.2 Fine aggregate (Sand)

The sand which is used for the experimental work was locally available and conformed to Indian Standard Specifications IS: 2386-2013 . The properties of sand which belongs to Grade Zone II. The different properties of fine aggregate are Specific gravity (2.343), Fineness modulus (3.015), Bulking of sand (27.53%) and Bulk density (16.70 KN/m^3)

2.3 Cement

In the present work we used Ordinary Portland Cement (OPC) and its brand name is ACC cement The 53 grade of ACC cement was used for casting of Cylinders and Beams. It is in gray colour and free from lumps. The main properties of cement are Specific gravity 3.24, Normal Consistency is 26.5%, Initial setting time is 39 mins and Final setting time is 185 minutes. Fineness 3% it is conformed to Indian Standard Specifications IS: 2386-2013 [6]

2.4 Aggregates

Stone coarse aggregate which is sieved through the sieve shakers and found the required size of 4.75mm in this work. The maximum sizes of aggregate are 16 and 10mm. The aggregates were tested as per Indian Standard Specifications BIS: 2386-2013. Angular aggregates with maximum grain size of 16 mm, 10 mm and downgraded were used. The main properties of angular aggregrates are specific gravity of 16 mm (2.629), 10 mm (2.74), Fineness modulus is 2.08, Crushing value 20% Impact value 20.36% and Water absorption 0.50%.

III. DETAILS OF SPECIMENS

3.1 For Cylinder

Figure 3:1 Specimen of Cylinder

Volume of Cylinder = $\pi d^2 l/4$

$= \pi \times 0.15^2 \times 0.30/ 4$

$= 0.00531\ m^3$

Volume of Cylinder = $0.00531\ m^3$

Cement : 425 x 0.00531=2.256kgs

Fine aggregate : 653 x 0.0053 =3.467kgs

Coarse aggregate

a) 16mm : 725 x 0.00531= 3.8425kgs

b) 10mm : 483×0.00531=2.559kgs

Water : 148.8 x 0.00531 = 0.78864litre

3.2 For Beam

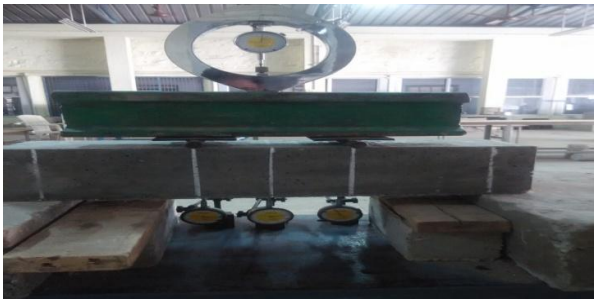

Figure 3:2 Specimen of Beam

Volume of beam = LXBXD

= 700x150x150

= $0.0157m^3$

Cement: 425x0.0157 = 6.6375kgs

Fine aggregate: 653x0.0157 = 10.281kgs

Coarse aggregate

a)16mm: 725x0.0157 = 10.875kgs

b)10mm: 483 x0.0157=7.60kgs

Water: 148.8x0.0157 = 2.232 litre

Super plasticizer for all=$0.004428m^3$4. TESTS ARE CONDUCTED

4.1 Split tensile strength test

Figure 4:1 Split tensile test on cylinders

The ingredients of the concrete i.e., cement, sand and aggregate were weighed and mixed dry. For dry mix the calculated quantity of PVA were added and the mixing was continued till a homogeneous mix was obtained. Then the calculated quantity of water was added and again mixed thoroughly.

There are two different specimens such as beam and cylinder were tested for 3, 7 and 28 days with each proportion of PVA [9]. The constituents were weighed and the materials were mixed by hand mixing. The mixes were compacted using vibrating needles. The water cement ratio adopted was 0.35. The specimens were remoulded after 24h, cured in dry area for 3, 7and 28 days, and then Split tensile tests are conducted in the machine.

The specimens were located on the Split tensile testing machine [3]. The dial gauges were placed on the particular locations. Load was applied on the specimen gradually. The load was applied continuously till the failure of the specimen takes place. The type of failure noted down carefully.

Computation of the split tensile strength was as follows.

Split tensile strength = $(2p/\pi dl)$

Where, p=load in KN

d=diameter of cylinder=150 mm

l=length of cylinder=300 mm

4.2 Flexural strength test

Figure 4:2 Flexural test on beams

Brush the beam fresh. Turn the beam on its side, with respect to its site as moulded and place it in the breaking machine [4]. The size of the beam specimen is 150x150x700mm. Arrange the test specimen by satisfying the concrete into the mould in 3 layers of approximately equal thickness. Fill each layer 35 times using the tamping bar as mentioned above. Tamping should be dispersed uniformly over the entire cross section of the beam mould and throughout the deepness of each layer.

Clean the bearing surfaces of the supporting and loading rollers, and remove any loose sand or other material from the surfaces of the specimen where they are to make contact with the rollers. Circular rollers manufactured out of steel which is having a cross section with diameter of 38 mm can be used for provided that support and loading points to the specimens. The length of the rollers shall be at least 10 mm more than the width of the test specimen. A total of four rollers shall be used, three out of which shall be capable of rotating along their own axes. The distance between the outer rollers (i.e. span) shall be **3d** and the distance between the inner rollers

shall be d. The inner rollers shall be equally spaced between the outer rollers, such that the entire system is systematic.

The test specimen shall be placed in the machine correctly centered with the longitudinal axis of the specimen at right angles to the rollers. For moulded specimens, the mould filling direction shall be normal to the direction of loading.

The load shall be applied at a rate of loading of 400 kg/min for the 15.0 cm specimens and at a rate of 180 kg/min for the 10.0 cm specimens.

Calculation of the flexural strength was as fallows.

Flexural strength = [(pl/bd^2) x1000]

Where,

P=load in KN

L=effective length of beam=700mm

b=width of the beam=150mm

d=depth of the beam=150mm

V. RESULTS AND DISSCUSION

5.1 Split tensile strength of all Samples

Samples	% of PVA	Split tensile strength at 28 S (N/mm^2)		
		28 days	7 days	3 days
Sample (a)	0	4.39	3.54	3.09
Sample (b)	0.03	5.7	4.1	3.12
Sample (c)	0.06	6.2	4.34	3.45
Sample (d)	0.12	6.72	4.47	3.59
Sample (e)	0.24	6.8	4.58	3.8

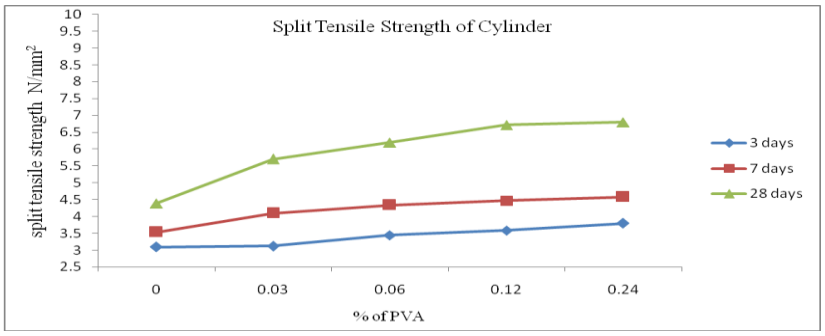

Figure 5:1 Split Tensile strength of a Cylinder at different percentages of PVA

The Split Tensile strength for the concrete mix gradually increased with the increase in % of PVA added up to 0.24% of PVA. The concrete mix ready by replacing the admixture of 0.24% of PVA which is having the more tensile strength. If there is a need of concrete with high tensile strengths in same grade of concrete the mix with 0.24% PVA can be adopted.

Through' the chart it can be said that the high tensile strength mix can be get at the percentage between 0.06% and 0.24%. But through our experiment we adopt that high tensile strength mix can be obtained by replacing 0.24% of fine aggregate by PVA. High tensile strength can be seen in the concretes with 0.24% of PVA.

5.2 Flexural Strength of all Samples

Samples	% PVA	Flexural Strength at 28 days (N/mm^2)		
		28 days	7days	3 days
Sample (a)	0	6.28	4.35	3
Sample (b)	0.03	6.98	4.52	3.6
Sample (c)	0.06	7	4.65	3.72
Sample (d)	0.12	7.1	4.7	4.03
Sample (e)	0.24	7.19	4.8	4.19

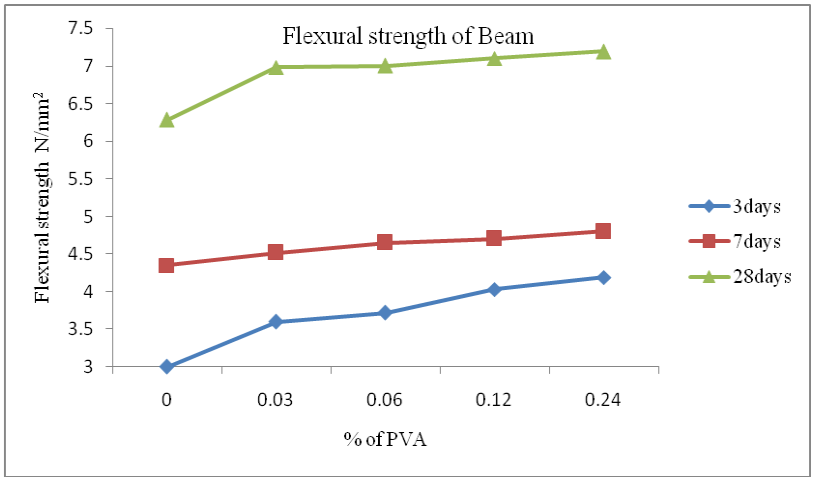

Figure 5:3 Flexural strength of a Beam at different percentage of PVA

The Flexural strength for the concrete mix gradually increased with the increase in % of PVA added up to 0.24% of PVA. From the above graph we can observe that the high flexural strength mix can be found at the percentage between 0.03 % and 0.24% [9]. But through our experiment we adopt that high flexural strength mix can be obtain by replacing 0.24% of fine aggregate by PVA. High flexural strength can be seen in the concretes with 0.24% of PVA.

VI. CONCLUSIONS

The following conclusions were drawn based on the investigation

- The Flexural strength for the concrete mix gradually increased with the increase in % of PVA added up to 0.24% of PVA. As percentages of PVA increases then flexural strength also increases for 3, 7 and 28 days at 0.24% of PVA.

- The high flexural strength 7.19 N/mm^2 could be observed in the concretes with 0.24% of PVA for 28 days.
- Finally the concrete mix with 0.24% of PVA gives the best self curing concrete mix with high flexural strength and high workability.
- The concrete mix ready by replacing the admixture of 0.24% of PVA which is having the more tensile strength for 28 days at 0.24 % of PVA.
- The split tensile test gives maximum tensile strength is 6.8 N/mm$^{2\ for}$ 28 days and also gives good strength for concrete construction.

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