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AN EXPERIMENTAL INVESTIGATION ON SELF-CURED CONCRETE

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ABSTRACT

Concrete is the most widely used construction material due to its good compressive strength and durability .Traditional concrete needs congenial atmosphere for attaining good strength, therefore moisture is provided for a minimum of 28 days for good hydration. The strength and durability of the concret1e is dependent on curing.. The high degree cement hydration problem due to improper curing, which can be successfully overcome by using self curing concrete. Hence no traditional way of curing is required in self curing concrete. Self curing concrete can be used where curing is a constraint because of inadequacy of water, fluoride content in water which affects concrete characteristics and where structures cannot be accessed for curing..

There are number of ways in which internal curing for concrete can be accomplished. One of the techniques of self curing concrete is by using hydrophilic materials in concrete. The use of hydrophilic materials in concrete minimizes the loss of water and also attracts moisture from the atmosphere and help in continuous curing in concrete. Poly Ethylene Glycol (PEG), Poly vinyl Alcohol (PVA), paraffin wax, acrylic acid is some of the commonly available hydrophilic materials in market. The present study which was carried out on standard concrete cubes of dimensions 150mmx150mmx150mm in which the variation of internal moisture content was measure by weighing the cubes at regular intervals. In this study, have been studied conventional concrete and self-cured concrete for compressive strength and tensile strength of similar mix design for 7 days and 28 days. The concrete cubes are exposed to environment in which chloride is present to find out the durability of self curing concrete and compressive strength of cubes are determined to find strength of cubes..

Keywords: Poly Ethylene Glycol (PEG), Poly Vinyl Alcohol (PVA), Compressive Strength.

I. INTRODUCTION

1.1 General

The desired properties in concrete can be obtained by proper curing if concrete in the initial stages. But, curing is not possible in all occasions because of some barriers and negligence. Many investigators were thinking about possibility of self-curing concrete and it led them and researchers in developing self-curing agents.

Self-curing agents mainly help in the retention of water in concrete by reducing evaporation because of hydration of concrete. When compared to conventional concrete self-cured concrete holds water from evaporation.

Water soluble alcohols such as Polyethylene glycol (PEG), polyacryl amide (PAM), poly vinyl alcohol (PAV) can be used as self curing agents in self-curing concrete. Self curing admixtures play a vital role in today's

condition where water is becoming an important asset which cannot be wasted for curing. For example $1m^3$ of concrete requires $3m^3$ of water.

Curing is done mainly to retain the moisture in concrete, by preventing evaporation from the concrete during the period in which it is attaining strength.

Curing can be done in many other ways and the best way will be dictated at site based on conditions at site.

1.2 Objects and Scope of Investigation

The purpose of this project is to study the effect of PVA (Poly Vinyl Alcohol, a water retaining alcohol) in curing process of concretes. The PVA is mixed of a sand concrete in various proportions 0.03%, 0.06%, 0.12%, 0.24%, 0.48 %polyvinyl alcohol by the weight of cement.

There is much published works on self curing concrete using materials like limestone powder, kiln ash, clinkers and some other chemical admixtures.

The properties of the concrete for the study in this investigation

1. Slump
2. Compaction factor
3. Compressive strengths

1.2.1 Objectives

Now a day's scarcity of sand is high and construction is also high for that reason in our project we have added PVA. But this PVA is not useful in more concrete construction. It will be used in where the water is less available areas only. Cost is also low.

1.2.2 Scope of Investigation

The main scope is to determine the compressive strength when P.V.A were added to aggregates.

II. EXPERIMENTAL WORK

2.1 General

In this investigation an attempt has been made to study the effect of PVA on physical properties of concrete. The properties of concrete used, the procedure used for concrete mixing and tests conducted are represented in this chapter. The mixing has been done in the laboratory. The properties considered in this study are strength and workability. The experimental Programme is broadly divided into following categories, viz. ,

1. Workability characteristics
   a) Slump
   b) Compaction factor test
2. Strength characteristics
   a) Compression test

2.2 Materials Used

In this section, the details pertaining to sand, cement, aggregates and PVA aggregates are described.

2.2.1 Sand

The sand used for this experimental investigation was locally obtained and conformed to Indian Standard Specifications IS: 383-1970. The sand was primarily sieved through 4.75 mm sieve to separate any particles greater than 4.75 mm. Characteristics of the fine aggregate used in this experimental study are tabulated in 2.1 .

The aggregates were sieved through a set of sieves as shown in table 2.2. To obtain sieve analysis and the same is presented in. The fine aggregated belonged to grading zone III.

Table 2.1 Properties of fine Aggregates

S. No.	Characteristics	Value
1	Type	Uncrushed (natural)
2	Specific gravity	2.68
3	Fineness modulus	2.507
4	Grading zone	III

2.2.2 Sieve Analysis

The portion of sand retained on 4.75mm sieve for the analysis. The quantity of sample to be taken shell depend upon the maximum particle size contained in the sand shown in the table 2.2

Table 2.2 Sieve Analysis of fine Aggregate

S. No.	Sieve No.	Mass Retained (gm s)	% Retained	% Passing	Cumulative %age Retained
1	4.75	95	9.5	90.5	9.5
2	2.36	42.5	4.25	86.25	13.75
3	1.18	110.5	11.05	75.2	24.8
4	600µm	128.5	30.8	62.35	37.65
5	300µm	308	28.1	31.55	68.45
6	150µm	281	3.45	3.45	96.55
7	Pan	34.5		_	
				ΣF =	250.7

Fineness Modulus of fine aggregate = ΣF/100

= 250.7/100

= 2.507

2.2.3 Cement

Grade 53 Sri Chakra cement was used for casting cubes for all concrete mixes. The cement is free from lumps and colour is uniform. Results of various tests conducted are summarized in table given below in Table 2.3

Table 2.3 Properties of Cement:

S.No	Characteristics	Values obtained	Standard values
1	Normal Consistency	33%	-
2	Initial Setting time	48 min	Not be less than 30 minutes
3	Final Setting time	240 min	Not be greater than 600 minutes
4	Fineness	4.80%	less than 10
5	Specific gravity	3.09	-

2.2.4 Aggregates

Coarse aggregate retained on 4.5mm sieve of number IS 480, which generally is crushed stones. The nature of work decides the maximum size of the coarse aggregate. Locally available coarse aggregate having the maximum size of 20 mm was used in our work. The aggregates used were tested as per IS Specifications IS: 383-1970.Table 2.4.shows the sieve analysis results and analysis of aggregates.

Table 2.4 Properties of Aggregate

S. No.	Sieve No.	Mass Retained (kg)	Retained, %	Passing, %	Cumulative % retained
1	80mm	-	0	100	0.0
2	40mm	-	0	100	0.0
3	20mm	0	0	100	0.0
4	12.5mm	2.1865	72.883	27.117	72.9
5	10mm	0.6745	22.483	4.634	95.4
6	4.75mm	0.139	4.633	0.01	100.0
7	PAN	0	0	-	-
				ΣC =	268.244

2.2.5 Polyvinyl Alcohol as Self Curing Agent

Commercially Polyvinyl alcohol is produced from polyvinyl acetate by a continuous process. The acetate groups are hydrolyzed by ester interchange with methanol in the presence of anhydrous sodium methyl ate or aqueous sodium hydroxide. Polyvinyl alcohol is an odorless and tasteless, translucent, white or cream colored granular powder. Polyvinyl alcohol contains two OH groups.

It helps to retain water in concrete. It is soluble in water, slightly soluble in ethanol, but in soluble in other Organic solvents. 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 180to 190*C

Polyvinyl alcohol is a water soluble synthetic polymer (not to be confused with polyvinyl acetate, apopular wood glue) Polyvinyl alcohol has excellent emulsifying and adhesive properties.PVA is fully degradable and dissolves quickly. PVA has a melting point of 230*C and 180-190*C.

III. DETAILS OF TEST SPECIMENS

Properties of concrete considered

(a) Slump cone test
(b) Compaction factor test
(c) Compressive strength of concrete
(d) Flexural strength
(e) Indirect tensile strength

3.1 Slump Cone Test

Table: 3.1 Slump Characteristics

S:no	% of PVA	Slump values	Increasing in slump values
1.	0	56	0
2.	0.03	58	0.03
3.	0.06	62	0.10
4.	0.12	64	0.14
5.	0.24	56	0
6.	0.48	56	0

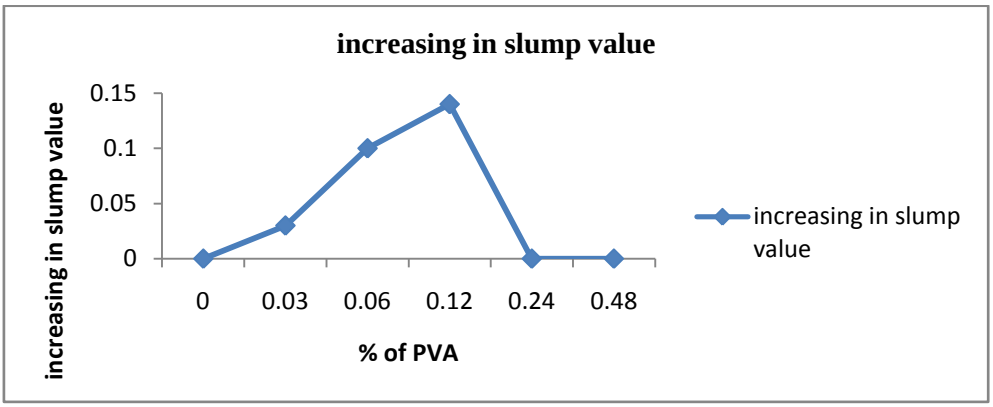

Fig: 3.1 Slump cone test of concrete mix 1:1.5:3

3.2 Compaction Factor Test

Table: 3.2 Compaction Values When % of PVA is Replaced.

Sr. no	% of PVA by the weight of cement	COMPACTION VALUE
1.	Conventional	0.9
2.	0.03	0.91
3.	0.06	0.91
4.	0.12	0.92
5.	0.24	0.92
6.	0.48	0.90

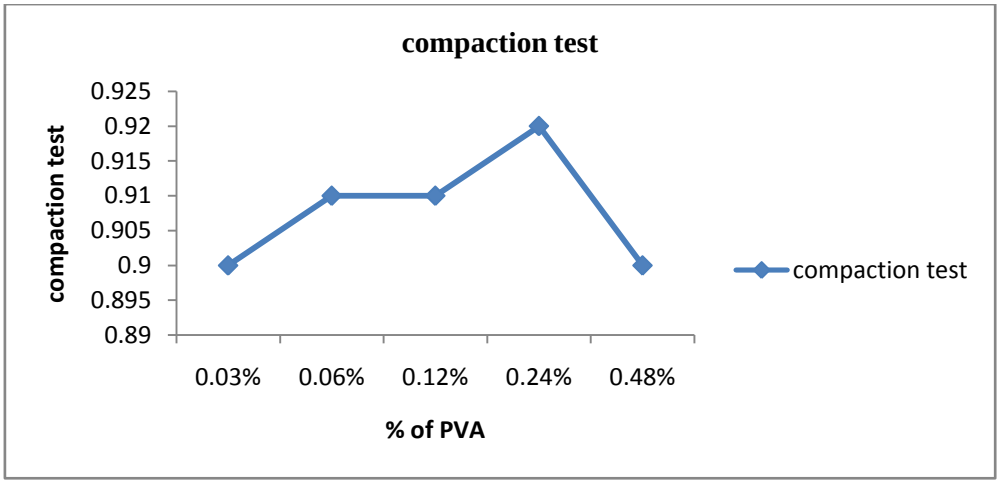

Fig: 3.2 Compaction Test of Concrete Mix 1:1.5:3

3.3 Compressive Strength

Table: 3.3 Compression Strength Values When % of PVA is Replaced.

Sr. no	% of PVA by the weight of cement	COMPRESSIVE STRENGTH FOR 7 DAYS	COMPRESSIVE STRENGTH FOR 14 DAYS	COMPRESSIVE STRENGTH FOR 28 DAYS
1.	Conventional	11.3	15.1	18.9
2.	0.03	10.3	14.9	16.7
3.	0.06	10.4	14.2	17.8
4.	0.12	11.1	14.8	18.6
5.	0.24	11.4	15.1	18.2
6.	0.48	10.4	13.9	17.4

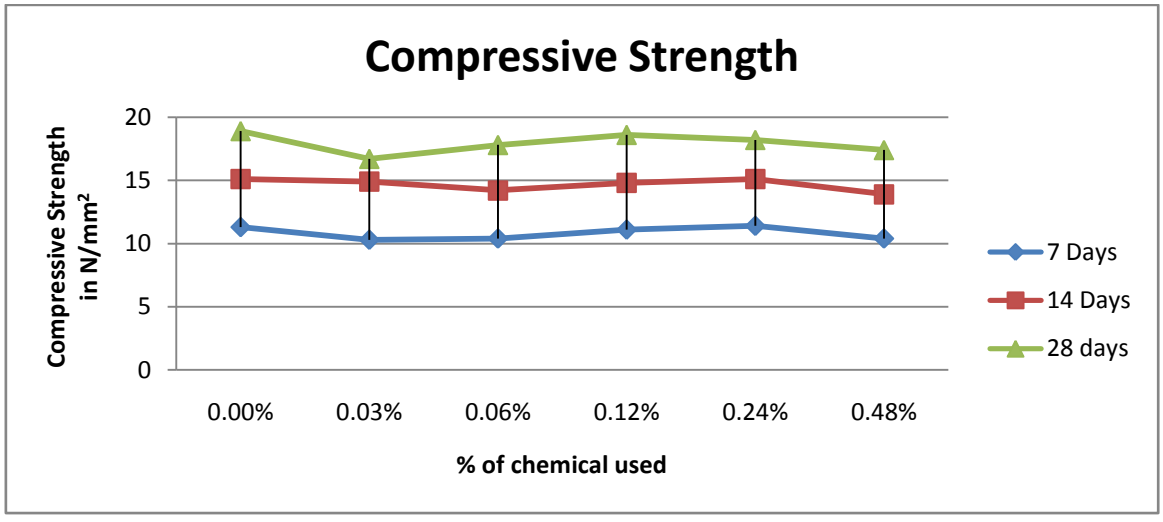

Fig. 3.3 Compressive Strength for 28 Days

3.4 Flexural Strength

Table: 3.4 Flexural Strength When % of PVA is Replaced.

Sr. no	% of PVA by the weight of cement	FLEXURAL STRENGTH 28 DAYS
7.	Conventional	5.856
8.	0.03	5.6
9.	0.06	6.54
10.	0.12	7.4
11.	0.24	7.0
12.	0.48	8.0

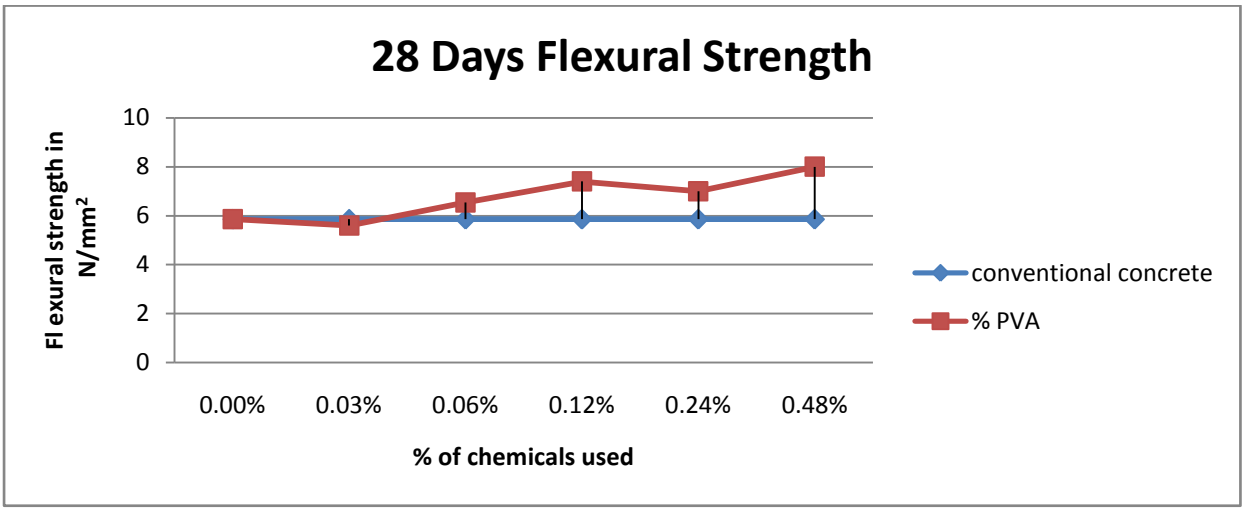

Fig. 3.4 Flexural Strength for 28 Days

3.5 Indirect Tensile Strength

Table: 3.5 Indirect Tensile Strength When % of PVA is Replaced.

Sr. no	% of PVA by the weight of cement	INDIRECT TENSILE STRENGTH 28 DAYS
1.	Conventional	4.30
2.	0.03	4.005
3.	0.06	4.215
4.	0.12	4.945
5.	0.24	4.920
6.	0.48	4.691

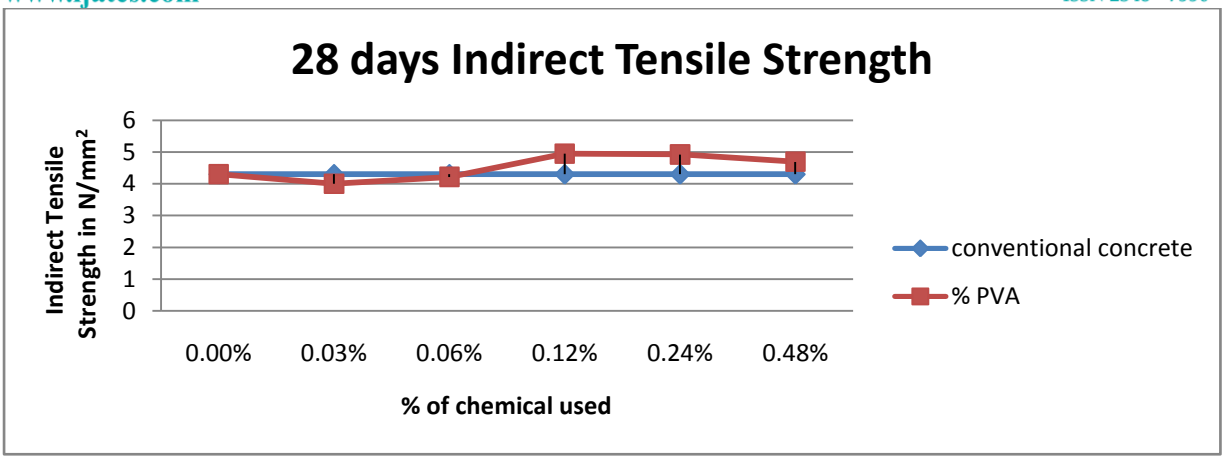

Fig. 3.5 Indirect Tensile Strength for 28 Days

IV. CONCLUSIONS

1. Water retention for the concrete mixes incorporating self-curing agent is higher when compare to conventional concrete mixes, as found by the weight with time.
2. When compared to conventional concrete, self-curing concrete resulted in better hydration with time under drying condition.
3. Cement content and the w/c ratio affects the performance of the self curing agent.
4. Compressive, tensile and flexural strength are higher when polyvinyl alcohol (0.48% by the weight of cement) is used as self -curing agent
5. When polyvinyl alcohol percentage increases, it results in reduction of weight loss.
6. Durability of self-curing concrete to sulphate salts and chloride induced corrosion and it is needed to be evaluated.

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