EXPERIMENTAL CHARCTERIZATION OF STRENGTH OF SELF CURING CONCRETE

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ABSTRACT

Today concrete is most widely used construction material due to its good compressive strength and durability. Depending upon the nature of work the cement, fine aggregate, coarse aggregate and water are mixed in specific proportions to produce plain concrete. Plain concrete needs congenial atmosphere by providing moisture for a minimum period of 28 days for good hydration and to attain desired strength. Any laxity in curing will badly affect the strength and durability of concrete. Self-curing concrete is one of the special concretes in mitigating insufficient curing due to human negligence paucity of water in arid areas, inaccessibility of structures in difficult terrains and in areas where the presence of fluorides in water will badly affect the characteristics of concrete. The present study involves the use of shrinkage reducing admixture polyvinyl alcohol in concrete which helps in self curing and helps in better hydration and hence strength. In the present study, the effect of self curing agent on compressive strength is examined by addition of varying percentage of PVA & Rice Husk Ash. PVA mixed in water from 0.5%,1%,2%,3%,4% & 5% by weight of cement. It was found that PVA could help in self curing by giving strength on par with conventional curing. It was also found that 3% of PVA by weight of cement was optimum for M20 grade concretes for achieving maximum strength (compressive nature) without compromising workability. Rice Husk Ash mixed in water from 5%,10%,15% & 20% by weight of cement. It was found that Rice Husk Ash could help in self curing by giving strength on par conventional curing .It was also found that 10% of Rice Husk Ash by weight of cement was optimum for achieving maximum strength. In this Paper to study the determining Modulus of elasticity Of Self Curing Concrete.

Key words: *Self curing agent, PVA, Rice Husk Ash, Admixtures, drying shrinkage, Water Retention.*

1. INTRODUCTION

Proper curing of concrete structures is important to meet performance and durability requirements. In conventional curing this is achieved by external curing applied after mixing, placing and finishing. Self-curing or internal curing is a technique that can be used to provide additional moisture in concrete for more effective hydration of cement and reduced self-desiccation. Internal curing (IC) is a method to provide the water to hydrate all the cement, accomplishing what the mixing water alone cannot do. Provides water to keep the relative humidity(RH) high, keeping self-desiccation from occurring. Eliminates largely autogenously shrinkage. Maintains the strengths of mortar/concrete at the early age (12 to 72 hrs.) above the level where internally & externally induced strains can cause cracking. Currently, there are two major methods available for internal curing of concrete. The first method uses saturated porous light weight aggregate (LWA) in order to supply an internal source of water, which can replace the water consumed by chemical shrinkage during cement hydration. The second method uses poly -ethylene glycol (PEG) which reduces the evaporation of water from the surface of concrete and also helps in water retention.

In this Paper We are using Polyvinyl Alcohol is the Compound of Poly-ethylene glycol. Polyvinyl alcohol was first prepared by Polyvinyl Hermann and Haehnel in 1924 by hydrolyzing polyvinyl acetate in ethanol with potassium hydroxide. Polyvinyl Alcohol is produced commercially from polyvinyl acetate, usually by a continuous process. Polyvinyl alcohol is classified into two classes namely: Partially hydrolyzed and fully hydrolyzed .Partially hydrolyzed PVA is used in the foods. Polyvinyl alcohol is an odorless and tasteless, translucent,White color in Cristal form. Polyvinyl alcohol is not known to occur as a natural product.

In this paper Second Self Curing agent is used in Rice Husk Ash. India is a major rice producing country Rice milling generates a by product known as rice husk. This surrounds the paddy grain. During the milling of paddy about 78% of the weight is received as rice. Rest of 22% weight of paddy is received as husk.RHA is much finer than cement having very small particle of 25 microns and fills the voids between cement and aggregate which give the strength and density of the concrete.so it can be reduce the amount of cement concrete mix.This ash is usually ground to finer powder it increases the compressive strength due to fineness also adding R.H.A.to the concrete even a small or low replacement will enhance the workability, strength of concrete.

2. LITERATURE REVIEW

"Strength characteristics of self-curing concrete "m.v.jagannadha kumar1, m.srikanth2, dr.k.jagannadha rao3

This study involves the use of shrinkage reducing admixture. The present study involves the use of shrinkage reducing admixture polyethylene glycol (PEG 400) in concrete which helps in self curing and helps in better hydration and hence strength. In the present study, the effect of admixture (PEG 400) on compressive strength, split tensile strength and modulus of rupture by varying the percentage of PEG by weight of cement from 0% to 2% were studied both for M20 and M40 mixes. It was found that PEG 400 could help in self curing by giving strength on par with conventional curing. It was also found that 1% of PEG 400 by weight of cement was optimum for M20, while 0.5 % was optimum for M40 grade concretes for achieving maximum strength without compromising workability.

" Investigations on self-compacted self-curing concrete using limestone powder and clinkers" c. Selvamony1, m. S. Ravikumar2, s. U. Kannan1 and s. Basil gnanappa3
In this study, the effect of replacing the cement, coarse aggregate and fine aggregate by limestone powder (LP) with silica fume, quarry dust and clinkers respectively and their combinations of various proportions on the properties of SCC has been compared. Fresh properties, flexural and compressive strengths and water absorption properties of Concrete were determined.

"Comparison of Compressive Strength Of Medium Strength Self Compacted Concrete By Different Curing Techniques" Prof. Nanak J Pamnani1, Dr. A.K. Verma2, Dr. D.R. Bhatt3.

In this paper variation in compressive strength of medium strength, self-compacted concrete with 3 different curing techniques is discussed. Initially several trials were carried out for mix design of medium strength self compacting concrete. Once the mix design was achieved, three batches of concrete cubes were cast as per ASTM standard. Water cement ratio and admixture dose were kept constant as required by selected Mix Design.

Wen-Chen Jau stated that self curing concrete is provided to absorb water from moisture from air to achieve better hydration of cement in concrete. It solves the problem when the degree of cement hydration is lowered due to no curing or improper curing by using self curing agent like poly-acrylic acid which has strong capability of absorbing moisture from atmosphere and providing water required for curing concrete.

Dr. J .V. Ramaswamy and P.R. Nagarajan "Rheological and Strength Characaristics of Concrete with Rice Husk Ash".

In this paper they have studied the various aspect of manufacturing the concrete with rice husk ash. The experimental investigations have been made to study suitability of use of rice husk ash a pozzolanic material for cement replacement in concrete. The properties studied include the rheological characteristics of fresh concrete such as slump, compacting factor and strength properties of hardened concrete includes compressive strength, split tensile strength, flexural strength for various percentage of replacement of cement by rice husk ash. The investigation shows that rice husk ash can be effectively used in concrete up to 10 % replacement of cement without affecting much of its strength characteristics. The main objective of this work is to study the suitability of rice husk ash as a pozzolanic material for cement replacement in concrete.

C. F. Njoku and M. O. Yusuf "Effect of Rice Husk as filler in concrete".

In this study the waste materials can partly be used, or processed, to produce materials suitable as aggregates or fillers in concrete. These can also be used as clinker raw materials, or processed into cementing systems. New grinding and mixing technology will make the use of these secondary materials simpler. Developments in chemical admixtures: superplasticizers, air entraining agents, etc., help in controlling production techniques and, in achieving the desired properties in concrete were decreased with increase of pumice aggregate and steel fiber ratio in the mixture.

M. A.Ahmadi "High performance Concrete Using Rice Husk Ash".

The paper reports the usefulness of R. H.A. in the development of economical High performance concrete. This paper presents a study on the development of Mechanical properties up to 180 days of self compacting and ordinary concretes with rice-husk ash (RHA), from a rice paddy milling industry in Rasht (Iran). This paper presents a study on development of strength of concrete. Based on the result of self compacting concrete specimens have higher value than normal concrete specimens in all test except modulus of elasticity. Also specimens with 20% replacement of cement by RHA have the best performance.

3. METHODOLOGY

Various materials used in concrete are as follows,

3.1 Cement: Cement act as binding material. It has property of setting and hardening when mixed with water to attain strength. The properties of cement is depends upon chemical composition, the process of manufacture & degree of fineness of cement grains. In this total project work Ordinary Portland cement of 53 grades was used.

3.2 Fine aggregates: Locally available sand was used. The focus will be placed on the characteristics of the fine aggregate. Out of the total composition of aggregate, the fine aggregate consumes around 20% to 30% of the volume. The sand is tested as per IS: 2386. It is the aggregate most of which passes through 4.75mm IS sieve. It was used in preparing self-curing concrete.

3.3 Coarse Aggregate: Locally available aggregate were used. The aggregate is tested as per IS 2386. 20 mm maximum size aggregate was used and retained on 12.5mm IS sieve.

3.4 Water: Water used for mixing shall be taken clean and free from injurious amount of oils, acids, alkalis ,salts, sugar, organic material and other substances that may be deleterious to concrete. water used for curing should not produce any objectionable deposit on the concrete surface. Tap water was used for the project work having ph was not less than 6.

3.5 Curing Compounds :
1) Polyvinyl Alcohol
2) Rice Husk Ash

3.5.1 Polyvinyl Alcohol: Polyvinyl Alcohol is the compound of Polyethelene Glycol. It is a water soluble synthetic soluble polymer. Polyvinyl alcohol is an odorless and tasteless, translucent, White color in Cristal form.

Fig -1: Chemical Structure of Polyvinyl Alcohol

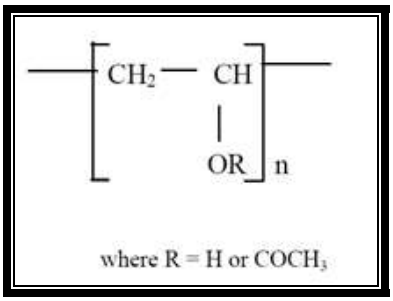

Fig -2: Photographic View of Polyvinyl Alcohol

3.5.2 Rice Husk Ash : Chemical analysis of rice husk ash indicates the presence of silica as primary constituents. Rice husk ash content silica in a highly reactive form is found to be an excellent ingredient for making rice ash concrete.

Fig -3: Photographic View of Rice Husk Ash

3.6 Mix proportion:

The concrete mix was prepared with the grade M20. The water cement ratio adopted was 0.5.

3.7 Curing condition:

All the cubes were demoulded after 24 hours after their casting and cured at room temperature in the range of 25^0c to 27^0c.All specimen were made to set at room temperature for 7 days and 28 days and then respective testings were taken.

3.8 Specimen and testing details:

The cubes of 150 mm*150mm*150mm size with cement: sand and aggregate of proportion of 1:1.5:3 were casted.The entire specimens were tested in compression testing machine till ultimate failure. The load at ultimate failure was noted for each specimen to calculate the compressive strength .The average of three cubes was considered as the compressive strength of the particular designation of the specimen set.

3.9 Methods :

Following flow chart shows the sequence of project works. And the parameter evaluated in this project work.

Chart 1: Sequence of project works

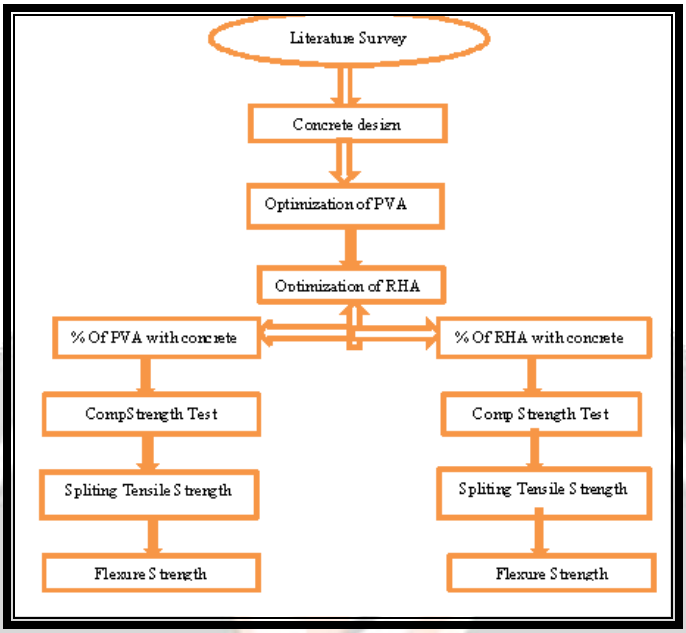

Table 1: Showing the number of specimen for various test

Sr.No	Project work	No.of Cubes	No.of Cylinders	No.of Beams	Curing period
1	Control mix (M20)	3	3	3	28days
2	To % of PVA				
	1	6	-	-	28days
	2	6	-	-	28days
	3	6	-	-	28days
	4	6	-	-	28days
	5	6	-	-	28days
3	To Optimum% Of PVA	-	3	3	28days
4	To % of RHA				
	10	6	-	-	28days
	20	6	-	-	28days
5	To Optimum % of RHA	-	3	3	28days

Above table1.shows the number of specimens casted to evaluate the compressive strength, splitting tensile strength & flexural strength of Self Curing Concrete made by using cement , PVA & RHA.

4. TEST & RESULTS:

4.1 General :

This chapter gives detail explanation of all the results and graphs obtained from experimentation which designate the effect of Curing on all structural parameter of Self Curing Concrete. For the experimental purpose; M20 grade concrete was prepared as per Indian Standard Method (IS: 10262:2009) OPC cement of 53 grades, Natural sand, 20mm coarse aggregate, Fine Aggregate, Polyvinyl Alcohol, Rice Husk Ash was used for experimentation. The proportion used for mixes were 0.5:1:1.654:3.073 (W/C ratio: cement: FA: CA). As per the mix design, control mix was prepared. To study different properties of harden concrete number of cubes, cylinders and beam were casted. The compressive, split tensile and flexural strength was determined at the age of 28 days of concrete. Compressive and splitting tensile strength of control mix was found to be 31.63 Mpa and 4.1Mpa respectively. Project executed by replacing cement by Polyvinyl Alcohol in the proportion of 0.5%, 1%, 2% ,3% ,4% ,5% of its weight with the Cement & replacing Cement by Rice Husk Ash in the proportion of 5%,10% ,15%, 20% .of its weight with the cement optimized percentage of 3% of PVA and 10% of Rice Husk Ash. These composite concrete specimens were tested at the age of 28 days with internal curing. The compressive, split tensile and flexural strength of resultant concrete was found and compared with the results of control mix concrete. From the results of flexural strength, we found the modulus of elasticity. By deep literature survey and experimentation, the project is concluded by obtaining relations between compressive, split tensile and flexural strength of Self Curing Concrete.

Polyvinyl Alcohol & Rice Husk Ash cubes were casted in mould (150*150*150) mm after 7 & 28 days Internal curing cubes in 3 nos. tested under compressive testing machine. The average compressive strength was found out shown in Table II & III Figure 4 and 5 shows graphical representation of strengths.

Table 2: Compressive Strength of the Polyvinyl Alcohol

Sr.No.	Percentage of Polyvinyl Alcohol	Avg.Compressive Strength after 7 days in N/mm^2 (Polyvinyl Alcohol)	Avg.Compressive strength after 28 days N/mm^2 (for Polyvinyl Alcohol)
1	0.5%	10.76	17.53
2	1%	11.86	16.1
3	2%	16.7	20.23
4	**3%**	**18.24**	**25.88**
5	4%	11.17	15.47
6	5%	6.2	12.87

Chart.2 Graphical representation Comp. Strength Vs % of Polyvinyl Alcohol by the weight of cement

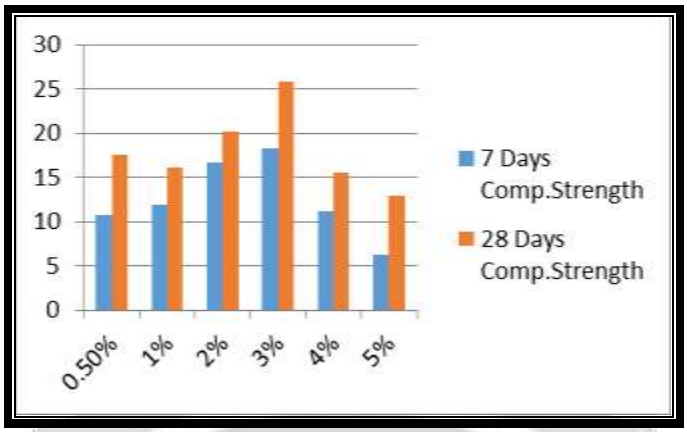

Table 3. Compressive Strength of the Rice Husk Ash

Sr.No.	Percentage of (Rice Husk Ash)	Avg.Compressive Strength after 7 days in N/mm^2 (for Rice Husk Ash)	Avg.Compressive strength after 28 days N/mm^2 (for Rice Husk Ash)
1	5%	12.87	18.20
2	**10%**	**22.29**	**26.4**
3	15%	13.56	19.5
4	20%	8.2	10.03

Chart.3 Graphical representation Comp. Strength Vs % of Rice Husk Ash by the weight of cement.

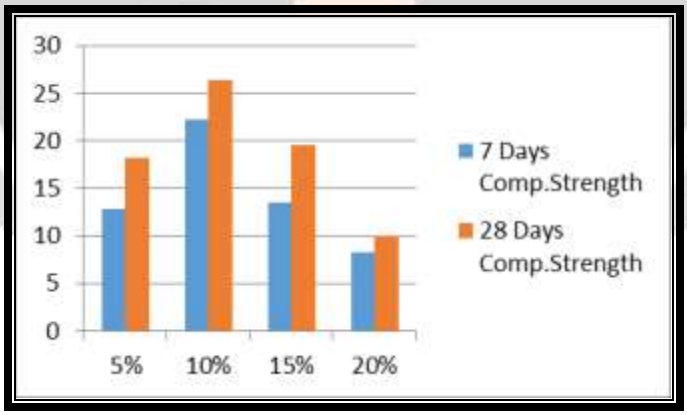

Fig.4 Photograph during cube casting

Fig.5 Photograph during cylinder casting

Fig.6 Photograph during beam casting

Fig.7 Photograph during internal curing at room temperature

Fig.8 Photograph during testing of specimen

5. CONCLUSION:

From the experimental work conducted on composite concrete ,the following conclusions can be drawn.

I. The use of poly vinyl alcohol & Rice Husk Ash in ordinary concrete of grade M20 was examined by experimentation.

II. It was found that for 3% optimum use of poly vinyl alcohol the strength is equals to characteristic strength of self curing concrete.

III. It was found that for 10% optimum use of Rice Husk Ash the strength is equals to characteristics strength of self curing concrete.

IV. Use of polyvinyl alcohol up to 3 % (by weight if cement) from to be effective in strength development increase in percentage of polyvinyl alocohol results in decrease in the compressive strength.

V. 5.From all combinations of composite concrete (10 percent Rice husk Ash, 90 percent OPC and 3 percent PVA) gives better results.

VI. The main objective of this work is to study the suitability of the rice husk ash as a Curing agent for cement replacement in Self Curing Concrete.

Future Scope:

1) Combinations of PVA with other Self Curing agent can be tried and effects will be examined of composite concrete.
2) It is expected that the use of rice husk ash in concrete improve the strength properties of concrete. Also it is an attempt made to develop the concrete using rice husk ash as a source material for partial replacement of cement, which satisfies the various structural properties of concrete like compressive strength and Flexural strength.
3) It is also expected that the final outcome of the project will have an overall beneficial effect on the utility of rice husk ash concrete in the field of civil engineering construction work.

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IS CODES

11. IS 516:1959 Method of test for strength of concrete
12. IS 10262:2009 Code for concrete mix design
13. IS 456 Plain and Reinforced concrete code of practice