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"Self Curing Compaction by using Liquid paraffinWax & Conplast SP 430".

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ABSTRACT

Cement is most generally utilized development material because of its great compressive quality and solidness. One of the significant parameter which impact quality is curing. Curing assumes a noteworthy part in building up the solid microstructure and pore structure. Curing is the way toward keeping up appropriate dampness content especially inside 28 days to advance ideal bond hydration promptly after situation. Great curing is not for all intents and purposes conceivable in the majority of the cases, for example, vertical individuals, human mistakes, places where there is shortage of water. In such conditions self curing cement is exceptionally versatile and alleviating the above issues. The self curing solid implies that no outside curing is required for cement. The idea of self curing cement is to decrease the water vanishing. As characterized by ACI, "Self or interior curing alludes to the procedure by which the hydration of bond happens in view of the accessibility of extra inner water that is not part of the blending water." One of the methods of self curing is by utilizing hydrophilic materials. A portion of the regularly accessible hydrophilic materials are Polyethylene Glycol, Paraffin wax, Acrylic corrosive. The utilization of hydrophilic materials minimizes the loss of water from the solid and aides in ceaseless curing of cement. In this study, considered review of cement is M40. The admixture utilized for self curing is Fluid Paraffin Wax, which is dry, scentless and dull. The impact of variety in quality parameters i,e., Compressive Strength, Split Tensile Strength and Flexural Strength were considered with Liquid Paraffin Wax (self curing specialist) (0.1% by weight of bond) and contrasted and that of traditional cured cement. The admixture Conplast SP430 was included (0.3% by weight of bond) in both traditional concrete and self curing concrete for increment of workability. The plan blend extent was 1:1.45:2.95. Quality of self curing cement is keeping pace with customary cement. From this study, reasoned that utilizing of Liquid Paraffin Wax as self curing operator can indicate critical variety in quality of cement.

I. Introduction

Cement is most broadly utilized development material because of its great compressive quality and sturdiness. Contingent on the way of work the bond, fine total, coarse total and water are blended in particular extents to create plain concrete cement. Plain bond solid needs amicable climate by giving dampness to a base time of 28 days for good hydration and to accomplish fancied quality. The properties of solidified cement, particularly the strength, are enormously impacted by curing since it remarkably affects the hydration of the concrete. Any laxity in curing will seriously influence the quality and solidness of cement.

sible dampness conditions to advance ideal bond hydration quickly after situation. Curing permits consistent hydration of bond and therefore persistent pick up in the quality. When curing stops quality pick up of the solid likewise stops. Legitimate dampness conditions are basic on the grounds that the hydration of the bond for all intents and purposes stops when the relative mugginess inside the vessels drops underneath 80%. Vanishing in the underlying stage prompts to plastic shrinkage splitting and in the last phase of setting it prompts to drying shrinkage breaking. Satisfactory curing is fundamental for cement to get basic and strength properties and hence is a standout amongst the most critical necessities for ideal solid execution. With inadequate water, the hydration won't continue and the subsequent cement is for all intents and purposes influenced, neglecting to give a defensive boundary against entrance of unsafe operators. Legitimate curing of solid structures is critical to meet execution and toughness prerequisites. Enough water is should have been available in a solid for the hydration of bond to happen. Be that as it may, even plan blend contains enough water, any loss of dampness from the solid will decrease the underlying water bond proportion and result in inadequate hydration of concrete particularly with the blends having low water concrete proportion. This outcomes in exceptionally low quality of cement.

Self curing concrete is one of the special concretes in mitigating insufficient curing due to human negligence, scarcity 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 concept of self curing agents is to reduce the water evaporation from concrete and hence increase the water

retention capacity of the concrete compared to conventional concrete. It was found that Hydrophilic materials (water loving. Such compounds have an affinity to water and are usually charged or have polar side groups to their structure that will attract water) such as Polyethylene Glycol, Paraffin wax, or Acrylic acid can be used as self curing agents in concrete. Concrete incorporating self curing agents will represent a new trend in the concrete constructions in the new millennium. Curing of concrete plays a major role in developing the concrete microstructure and pore structure, and hence improves its durability and performance. The use of self-curing admixtures is very important from the point of view that water resources are getting valuable every day (i.e., each 1 m3 of concrete requires about 3 m3 of water for construction most of which is used for curing).

II. Problem Definition and Goal

The main objective of this investigation is to develop self curing concrete using Liquid

In addition, it is also aimed to compare the strength characteristics of M40 grade conventional concrete.

Two types of curing methods viz., Indoor curing (air curing) and Conventional curing (by immersing the specimens in water) were adopted.

For the entire study considered M40 grade of concrete only.

Study of the effect of eggshell powder as a binder to increase bearing capacity of soil. Study of the strength behaviour clayey soil mixing with rock dust and eggshell powder. Increasing safety factor against slope, and earth dam sliding. Study on PI, UCC, DFS, Shrinkage limit properties of soil when mixed with quarry dust and eggshell powder.

III. Literature Survey

Garje Rajesh Kumar (2011) Studied that among the various ways of internal curing for concrete, one of the technique 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 of concrete. The paper discusses the experimental investigation to arrive at the optimum dosage of Polyethylene Glycol (PEG) in concrete. The parameters in the study are with two grades of concrete, PEG of two molecular weights, different dosage of PEG and two curing conditions. Two grades of concrete i.e., M30 and M40 were considered. Polyethylene Glycol (PEG) of two molecular weights 600 and 6000 was added in dosages 0.1%, 1.0% and 3.05 by weight of cement. Two types of curing methods indoor curing and conventional curing by immersing the specimens in water were adopted in the study. Concrete cubes of sizes 150mm×150mm×150mm were casted an amount of water retained in concrete under different curing methods and variation of compressive strength ware studied. It was conclude that:

M.V.Jagannadha Kumar, M.Srikanth, Dr.K.Jagannadha Rao Studied that self curing concrete is provided to absorb water from moisture from air to achieve better hydration of cement in concrete. In this shrinkage reducing admixture polyethylene glycol (PEG 400) is a self curing compound. Two types of grades are taken i.e., M20 and M40 grades of concrete. In this study the self curing agent is added to concrete with 0.5%, 1%, 1.5%, 2% by weight of cement. The experimental programme involves the compressive, tensile and modulus of rupture for M20 and M40 grades of concrete. For M20 grade of concrete totally 15 cubes, 15 cylinders, 15 beams are casted. Similarly for M40 grade of concrete totally 15 cubes, 15 cylinders, 15 beams are casted to evaluate the strength properties. The size of the cube is 150mm×150mm×150mm, size of cylinder is 300mm×150mm and size of beam is 100mm×100mm×400mm. The investigation aimed at studying on concrete with different quantities of cement for M20 grade of concrete is (340Kg/m3) and for M40 grade for concrete the cement content was found to be 440kg/m3 for both for self and air- curing concrete and compare the results for different test. It was conclude that:

i) The optimum dosage of PEG400 for maximum strengths (compressive, tensile and modulus of rupture) was found to be 1% for M20 and 0.5% for M40 grades of concrete.

ii) As percentage of polyethylene glycol (PEG400) increases automatically slump increases for both M20 and M40 grades of concrete.

Amal Francis k, Jino John Investigated on mechanical properties of self curing concrete. In this shrinkage reducing admixture superabsorbent polymer(SAP) is a self curing compound. The grade of concrete was found to be M40. In this study the self curing agent is added to concrete with 0%, 0.2%, 0.3%, 0.4% by weight of cement. The experimental programme involves the compressive, tensile and flexural strength for M40 grade of concrete. The size of the cube is 150mm×150mm×150mm, beam dimensions are 100mm×100mm×400mm, cylinder dimensions are 300mm×150mm. The investigation aimed at studying on concrete with different quantities of cement for M40 grade of concrete is (350Kg/m3). The compressive strength, flexural, split tensile results are taken at 3, 7, 28 days of curing and compare the results with air curing It was conclude that:

i) The optimum dosage of SAP for maximum strengths (compressive, flexural, split tensile strength) was found to be 0.3% for M40 grade of concrete.

study, and aimed at determining the effect of eggshell ash on the strength properties of cement-stabilized lateritic soil. All proportions of cement and eggshell ash contents were measured in percentages by weight of the dry soil. The Compaction test, California Bearing Ratio test, Unconfined Compressive Strength test and Durability test were carried out on the soil-cement eggshell ash mixtures. The increase in eggshell ash content increased the Optimum Moisture Content but reduced the Maximum Dry Density of the soil-cement eggshell ash mixtures. Also the increase in eggshell ash content considerably increased the strength properties of the soil-cement eggshell ash mixtures up to 35% in the average but fell short of the strength requirements except the durability requirement was satisfied.

III. Proposed Work

Methodology

One of the techniques of self curing is by using hydrophilic materials. Some of the commonly available hydrophilic materials are Polyethylene Glycol, Paraffin wax, Acrylic acid. The use of hydrophilic materials minimizes the loss of water from the concrete and helps in continuous curing of concrete.

IV. Experimental Programme

Preliminary work

In this chapter the experimental programme involves with the properties of materials and procedures of all the hardened concrete tests that were conducted.

i) To study the strength characteristics such as compressive strength, flexural strength, split tensile strength for M40 grade of concrete.

ii) Total 18 cubes were casted with dosage of 0.1% (by weight of cement) self curing agent (liquid paraffin wax) under

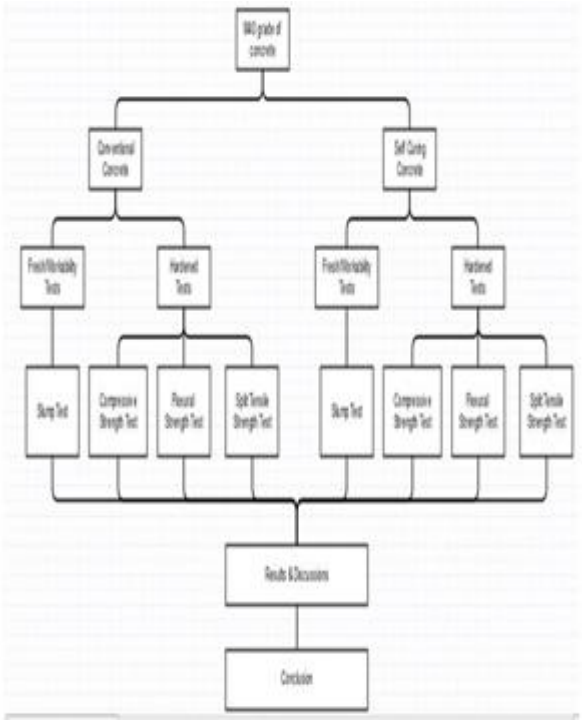

Figure 1. Methodology.

different curing conditions. Compressive strength test was conducted after 7, 14 and 28 days of curing.

iii) Total 18 cylinders were casted with dosage of 0.1% (by weight of cement) self curing agent (liquid paraffin wax) under different curing conditions. Split tensile strength test was conducted after 7, 14 and 28 days of curing.

iv) Total 18 prisms were casted with dosage of 0.1% (by weight of cement) self curing agent (liquid paraffin wax) under different curing conditions. Flexural strength test was conducted after 7, 14 and 28 days of curing.

v)The graphs plotted between strength (compressive strength, flexural strength, split tensile strength) and days of curing

Table 1. Proportions of different size fractions to obtain 20mm aggregate.

Sieve sizes (mm)	Weight retained (gm)	% weight retained	Cumulative % weight retaines	%passing
80	0	0	0	100
40	0	0	0	100
20	490	9.8	9.8	90.2
10	4411	88.22	90.02	1.98
4.75	99	1.98	100	0

Table 2. Proportions of different size fractions to obtain 10 mm aggregate.

Sieve sizes (mm)	Weight retained (gm)	% weight retained	Cumulative % weight retaines	%passing
12.5	0	0	0	100
10	875	17.5	17.5	82.5
4.75	1980	39.6	98.7	1.3
2.36	65	1.3	100	0

Fine aggregate

The sand was sieved through a set of sieves (i.e. 4.75mm, 2.36mm, 1.18mm, 600µ, 300µ and 150µ). Sand retained on each sieve was filled in different bags and stacked separately. To obtain zone – II sand correctly, sand retained on each sieve is mixed in appropriate proportion.

i) The fineness modulus for fine aggregate

Table 3. Proportions of different size fractions to obtain zone-III sand.

Sieve sizes (mm)	Weight retained (gm)	% weight retained	Cumulative % weight retaines	%passing
4.15mm	25	25	25	99.5
2.36mm	52	5.2	7.7	99.1
1.18mm	161	16.1	23.8	97.2
600 µ	355	35.5	59.3	67.2
300 µ	364	36.4	95.7	13.6
150 µ	36	3.6	99.3	2.2
75 µ	5	0.5	99.8	0.0
Pan	2	0.2	100	0

Water

This is the least expensive but most important ingredient of concrete. The water, which is used for making concrete, should be clean and free from harmful impurities such as oil, alkali, acid, etc; In general, the water, which is fit for drinking, should be used for making concrete. The results of various tests on water are given below

Table 4. Physical properties of water.

S.No	Parameter	Value
1.	P^H	7.10
2.	Taste	Agreeable
3.	Appearance	Clear
4.	Turbidity(NT Units)	1.75
5.	Hardness (mg/I)	250

Table 5. Physical properties of Liquid Paraffin wax.

S.No	Parameter	Value
1.	Fresh point	$>180^0$
2.	Apperarance	Clear colour less liqud
3.	Specfic gravity	>1
4.	Vapaur density (air=1)	<0.01 mmHg at 2.0^0C
5.	Solubility in water	Insotuble sotube in petroleum solvents

Mixing

It was found that the fresh concrete was dark in colour. The amount of water in the mixture played an important role on the behavior of fresh concrete. When the mixing time was long, mixtures with high water content bleed and segregation of aggregates and the paste occurred. This phenomenon was usually followed by low compressive strength of hardened concrete. Conplast SP430 and Liquid Paraffin wax were mixed in water thoroughly and then added to the mixture. The effects of water content in the mixture and the mixing time were critical parameters which decide the concrete should be within five to seven minutes as for the concrete and while mixing the following steps should be followed:

i) First mix all dry materials in the pan mixer.

ii) Add the liquid component of the mixture at the end of dry mixing, and continue the wet mixing for another four minutes

The standard moulds were fitted such that there are no gaps between the plates of the moulds. If there are small gaps they were filled with plaster of pairs. The moulds then oiled and kept ready for casting. A pan mixer of having 90 kg capacity was used for mixing concrete and the super plasticizer was used for workability purpose as per the specifications and calculations. This was dispersed in water in required proportion before mixing the water with the ingredients coarse, fine aggregates, cement. Water and super plasticizer along with Self-Curing agent were added subsequently. After 24hrs of a casting the moulds were kept under curing for the required number of days before casting.

Figure 2. Mixing of materials in 90 kg mixer.

Casting

The standard moulds were fitted such that there are no gaps between the plates of the moulds. If there are small gaps they were filled with plaster of pairs. The moulds then oiled and kept ready for casting. A pan mixer of having 90 kg capacity was used for mixing concrete and the super plasticizer was used for workability purpose as per the specifications and calculations. This was dispersed in water in required proportion before mixing the water with the ingredients coarse, fine aggregates, cement. Water and super plasticizer along with Self-Curing agent were added subsequently. After 24hrs of a casting the moulds were kept under curing for the required number of days before casting.

For all test specimens, moulds were kept on table vibrator and the concrete was poured into the moulds in three layers by tamping with a tamping rod and the vibration was effected by table vibrator after filling up moulds. The concrete filled moulds are shown in plate. The specimens were taken after twenty four hours and were kept immersed in clean water tank upto the specified period of curing. Before testing the specimens were taken out dried under shade and weights of the specimens were noted.

Figure 3. Casting of cubes

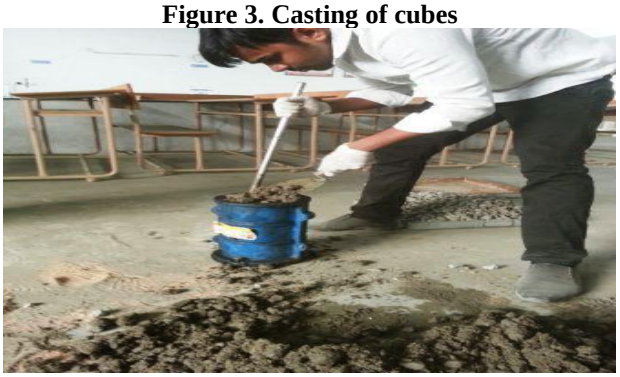

Figure 4. Cylinders casted

Curing

After completion of casting all the specimens were kept to maintain the ambient conditions viz., temperature of 27±2 C and 90% relative humidity for 24hrs. The specimens were removed from the mould and some cubes are kept in water for water curing and some are kept in lab for indoor curing.

V. Test Results

The experimental results were presented and discussed. Each of the compressive strength, indirect tensile strength and flexural strength test data plotted in figures corresponds to the mean value of the three test concrete cubes, cylinders and beams in series.

Slump Test

The slump test is performed to know about workability. The following are the observations on slump test.

Table 6. Slump test results

Nomenclature of mix	Slump (mm)
OPC+0.3% Corplast	125 mm
OPC+0.1%pw+0.3% Corplast	110 mm

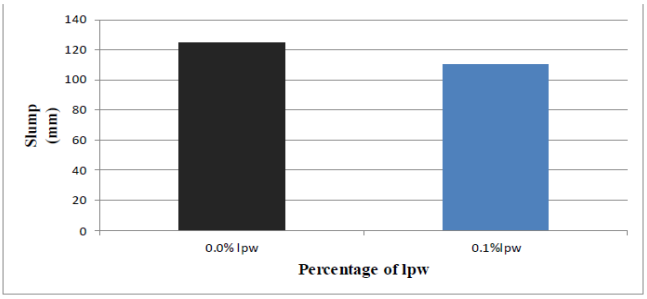

Figure 5. Variation of slump due to liquid paraffin wax.

From table 6, it was observed that, there was a decrease in the percent of slump of 12% in self curing concrete when compared to conventional concrete.

Compressive Strength Test Results

Table 7. Compressive Strength of Conventional concrete.

Nomenclature of mix	Curing Period		
	7 days (N/mm^2)	14 days (N/mm^2)	28 days (N/mm^2)
OPC+0.1%pw+0.3% Corplast(Air curing)	21.96	35.74	47.36

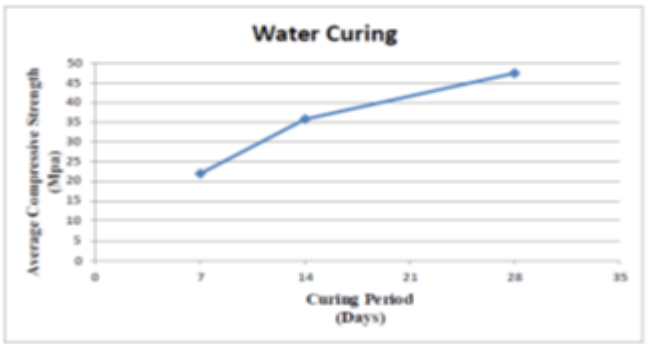

Figure 6. Compressive Strength of Conventional concrete.

From table 7, it was observed that, there was an increase in compressive strength of 36.65% at 14 days and 51.53 % at 28 days when compared to 7 days.

Table 8. Compressive Strength of 0.1 % liquid paraffin wax.

Nomenclature of mix	Curing Period		
	7 days (N/mm^2)	14 days (N/mm^2)	28 days (N/mm^2)
OPC+0.1%pw+0.3% Corplast(Air curing)	21.96	35.74	47.36

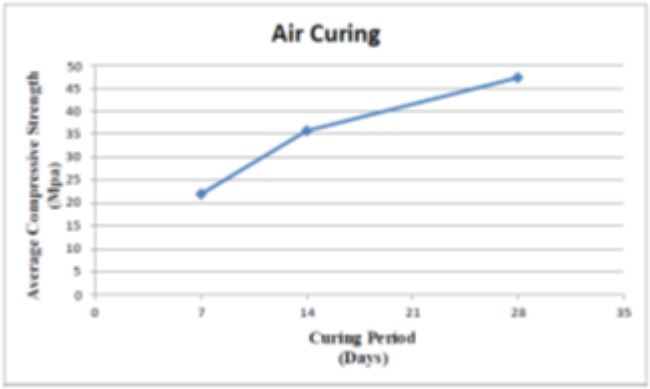

Figure 7. Compressive Strength of 0.1 % liquid paraffin wax

From table 8, it was observed that, there was an increase in compressive strength of 38.56% at 14 days and 53.63 % at 28 days when compared to 7 days.

Table 9. Compressive Strength Test Results.

Nomenclature of mix	Curing Period		
	7 days (N/mm^2)	14 days (N/mm^2)	28 days (N/mm^2)
OPC+0.3% Complast(Water curing)	23.30	36.78	48.07
OPC+0.1%pw+0.3% Corplast(Air curing)	21.96	35.74	47.36

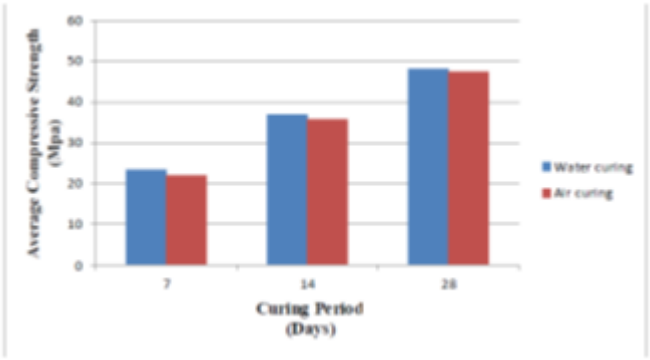

Figure 8. Variation of Compressive strength with age

It was observed that there was reduction in compressive strength of self curing concrete (air curing) of 5.75% when compared to conventional concrete (water curing) at 7 days.

It was observed that there was reduction in compressive strength of self curing concrete (air curing) of 2.83% when compared to conventional concrete (water curing) at 14 days.

It was observed that there was reduction in compressive strength of self curing concrete (air curing) of 1.48% when compared to conventional concrete (water curing) at 28 days.

Split Tensile Strength Test Results

Table 10. Split Tensile Strength of Conventional concrete.

Nomenclature of mix	Curing Period		
	7 days (N/mm^2)	14 days (N/mm^2)	28 days (N/mm^2)
OPC+0.3% Complast(Water curing)	3.82	4.53	5.49

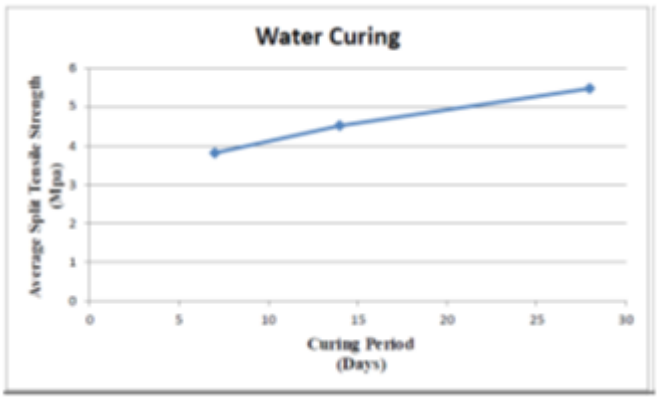

Figure 9. Split Tensile Strength of Conventional concrete.

From table 6.5, it was observed that, there was an increase in Split Tensile strength of 15.67% at 14 days and 30.42% at 28 days when compared to 7 days.

Table 11. Split Tensile Strength of 0.1% liquid paraffin wax.

Nomenclature of mix	Curing Period		
	7 days (N/mm^2)	14 days (N/mm^2)	28 days (N/mm^2)
OPC+0.1%pw+0.3% Corplast(Air curing)	3.54	4.10	5.15

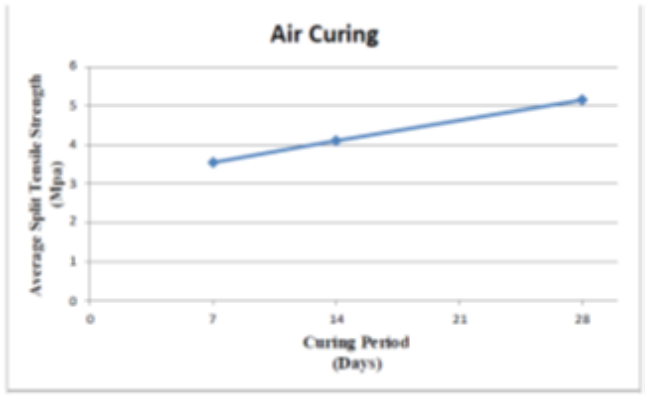

Figure 10. Split Tensile Strength of 0.1% liquid paraffin wax.

From table 11, it was observed that, there was an increase in Split Tensile strength of 13.66% at 14 days and 31.26% at 28 days when compared to 7 days.

Table 12 Split Tensile Strength results

Nomenclature of mix	Curing Period		
	7 days (N/mm^2)	14 days (N/mm^2)	28 days (N/mm^2)
OPC+0.3% Complast(Water curing)	3.82	4.53	5.49
OPC+0.1%pw+0.3% Corplast(Air curing)	3.54	4.10	5.15

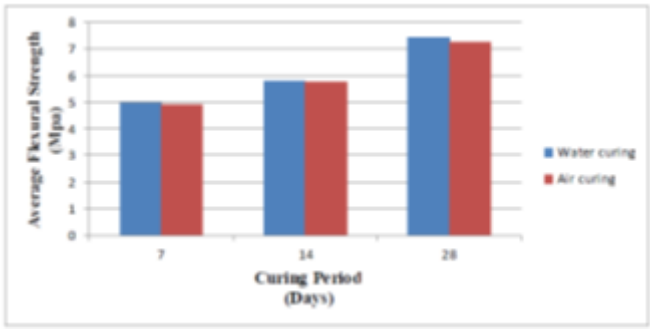

Figure 11. Variation of split tensile strength with age.

i) It was observed that, there was reduction in split tensile strength of self curing concrete (air curing) by 7.33% when compared to conventional concrete (water curing) at 7 days.
ii) It was observed that, there was reduction in split tensile strength of self curing concrete (air curing) by 9.49% when compared to conventional concrete (water curing) at 14 days.
iii) It was observed that, there was reduction in split tensile strength of self curing concrete (air curing) by 6.19% when compared to conventional concrete (water curing) at 28 days.

VIII. Conclusion

Following are the major conclusions drawn from the study:
i) The slump of Self Curing Concrete was decreased by 12% when compared to conventional concrete.
ii) The compressive strength of Self curing concrete decreased by 1.48% when compared to Conventional concrete.
iii) The split tensile strength of Self curing concrete decreased by 6.19% when compared to Conventional concrete.
iv) The flexural strength of Self curing concrete decreased by 2.02% when compared to Conventional concrete.
v) Strength of Self curing concrete is on par with conventional concrete.

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