

To Study The Strength Characteristics of Concrete By Replacing Curing Water With Self-Curing Compounds

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Abstract- As the portion of advance materials, cement is a most widely utilized material because of its strength and durability properties. Reliant upon the type of work, the cement, fine aggregates, coarse aggregates and water are mixed at various levels to produce plain concrete. Conventional concrete necessities curing for a time of 28 days for better hydration and to attain pronounced compressive strength. Without accurate curing, the concrete will poorly impact the strength and durability. Self-curing concrete is one of the distinct concrete to setback the issues like inadequate curing because of the human negligence and in areas wherever inadequate water is present. Regular studies are completed on behalf of the convention of self-curing concrete. In this current effort the Shrinkage Reducing Admixture of PEG-4000 and Super Absorbent Polymer (Sodium poly acrylate) make use of the self-curing agent at dissimilar ranges of 1.5% and 3% & 0.1% to 0.5% by the weight of cement in concrete which assistances in self-curing and in better hydration in addition to it, it gives good compressive strength. The main objective of this work is to generate M30 grade of concrete by way of using the admixture of PEG-4000 and internal curing agent to the weight of cement and to estimate the mechanical and durability properties at different ages i.e., 3days, 7days, 28days, 56days and 90days. The split tensile test, Non-destructive test were showed at 28days. Durability tests like RCPT were directed for 60days. The results publicized that by taking 1.5%SRA at 0.2%SAP to the weight of cement, we observed that 13% greater than before in compressive strength, 24% improvement in split tensile strength once compared with conventional concrete. By means of increasing the proportion of SAP to the weight of cement the compressive strength and tensile strength were reduced. The durability test i.e., RCP T test results published that the concrete quality is moderate for conventional curing concrete, 1.5%SRA at 0.1%, 0.2%SAP & 3%SRA at 0.1%, 0.2% SAP specimens.

Keywords- Concrete, Cement, Curing Compound, Polymer, Admixture, Durability.

I. INTRODUCTION

During the most recent two decades, concrete technology has been experiencing fast change. In the previous couple of decades, inward curing of cement has picked up ubiquity and is relentlessly advancing from research centre to field of practice. Now a day's numerous systems are presented and quick change in the concrete technology. Self-curing procedures is one of the systems, utilized as a part of less water asset ranges. Curing is the name given to the techniques utilized for advancing the hydration of the bond, and comprises of a control of temperature and of dampness development from and in to the concrete. Curing permits constant hydration of bond and hence ceaseless increase in quality, once the curing stops quality addition of the cement likewise stops. Legitimate dampness conditions are basic on the grounds that the hydration of the bond for all intents and purposes wrinkles when the relative stickiness inside the vessels drops beneath 80%. Within adequate water, the hydration won't continue and the sub sequent cement may not have the alluring quality and impermeability. The creaseless pore structure framed on the close surface may permit the entrance of pernicious specialist and bring about different studies issues. Moreover because of early drying of the concrete minimized scale breaks or shrinkage splits would create on surface of the concrete. At the point when cement is prevented to the earth vanishing of water happens and loss of dampness will diminish the underlying water bond proportion which will results in the in adequate hydration of the concrete and consequently bringing down the nature of the concrete.

1.1 METHODS OF SELFCURING



II. SELF-CURING CONCRETE(SCC)

Inside curing has been characterized by the American concrete institute ACI-308 code express that “inner curing alludes to the procedure by which hydration of bond happens in light of the accessibility of extra inward water that is not some portion of blending water”. “Interior curing” is frequently called as self curing. Self curing cement can be accomplished by including self curing agent. It was absorbed that water solvent polymers can be utilised as noteworthy part in building up the concrete micro structure and hence forth enhances its toughness and execution. Most clearing blends contain satisfactory blending water to hydrate the blending water to hydrate the concrete if the dampness is not permitted to dissipate. It ought to be conceivable to create oil, polymer or other exacerbate that would ascend to the completed concrete surface and viably seal the surface against evaporation. Since the interior curing water is a part of the frame work and it is finely scattered, it can conquer the issues of low penetrability and low w/c proportion, which destructively influences the productivity of customary outside curing strategies. By this implies, utilization of inner water supplies can be considered as the best strategy for decreasing auto geneous shrinkage, since it clearly influences self-desiccation. A concrete can be made to self curing by including admixtures or by the utilization of curing mixes.

III. BENEFITS OF SELF-CURING CONCRETE

Inwards curing compensate for a portion of the inadequacies of outside curing, both human related and hydration related with in basic curing period between 12 to 72 hours since hydration items stop up the ways required for the concrete particles yearning of water.

The advantages from IC can be normal when

- Cracking of cement gives way bringing about crumbling of fortifying steel
- Permeability or strength must be made strides

- IC gives water to keep the RH high, keeping self-drying up from happening
- IC kills to a great extent autogenous shrinkage
- Greater use of concrete
- Lower upkeep
- Higher modulus of versatility
- Greater curing consistency
- Increase/ keep up the quality of cement if the ideal measurement of self-curing admixture is utilized.

IV. SUPER ABSORBENT POLYMERS

Super Absorbent Polymer(SAP) are polymeric material that be able to ingest a lot of fluid from the surrounding and for assimilation of watery arrangements and, in amazing cases, they may have a water uptake of 5000 times their own particular weight. Standard, mechanical quality SAPs regularly have water ingestion of 100 to 400 g/g dry, and they can be created in any size and shape. SAPs have a place with the gathering of supposed “brilliant material”-material that, controlled, essentially changes their properties in light of an

external stimulus. At the point when SAPs are prevented to water, they swell, and when in this way subjected to drying, they reversibly contract. These key properties can effectively be utilized s a part of connection to concrete.

4.1 IMPORTANCE OF SAP

The SAP ingests water and changes over it into gel, and then discharges it gradually with time, in the meantime the gel- volume increments relatively. This property is valuable with regards to watering plants after sometime. The development in volume tends to stop up the water pathways in the concrete mass, and thusly enhancing its water tightness properties. The utilization of SAP is ended up being extremely successful as a sealant in plain concrete if adequate sum is utilized. This study concentrates on the long term impact and in addition the fleeting impact of the utilization of the SAP in plain concrete. A few examples were set up with various SAP content. The substance of SAP is measured as a rate of the Portland cement utilized by weight. The measure of water added to the fresh cement is a standout amongst the most imperative key components that influence the concrete properties, including water tightness, durability and quality.

4.2 METHODS OF NEUTRLISATION IN THE MANUFACTURE OF SAP

In the production of most superabsorbent polymer there are two courses that can be taken. The balance phase of the procedure can be done in the monomer arrangement before

the polymerization (pre-neutralisation) or on the polyacrylic acid gel (post-neutralization).

Pre-neutralization – This is the most effortless from a specialized outlook on the grounds that the balance of the monomer can happen in the fluid stage (generally with sodium or hydroxide arrangement). The solvency of some writes of cross-linker is influenced by the pH of the monomer arrangement, so this is an imperative element to consider while selecting the sort of procedure to produce superabsorbent.

Post-neutralization – Requires the blending of a strong gel with, regularly, a solid neutralizing agent, for example, sodium carbonate or a fluid neutralizing agent, for example, sodium hydroxide. Mixing solids is more troublesome than fluids and requires more vitality. Cruel mixing conditions can be prompt the breaking of polymer chains and the loss in execution of the polymer. Deficient joining of the neutralizing agent likewise hurt execution. These are components to consider while selecting a pre-neutralizing process.

V. SCOPE & OBJECTIVE

The goal of the present work is to create concrete will great quality, less permeable, less capillarity so strength will be come to. For this reason for existing is to concentrate on the mechanical qualities of cement, for example, compressive strength, split tensile strength by shifting the rate of super absorbent polymer from 0% to 0.5% by the weight of cement of M30 evaluation of cement. So the exploratory project to be attempted;

- To discover the rate utilization of admixtures doable for development
- To control the extent with PEG and SAP to be added to accomplish the alluring requirements for cement
- To decide the water/binder proportion, so plan cement having appropriate workability and quality.
- To explore diverse essential properties of cement, for example, compressive strength, partrigidity and so forth., and contrasting the outcomes and routine concrete and self-curing concrete with various proportioning.
- For safe development, to discover the amount of rate of PEG and SAP is added to the concrete to accomplishes quality at greatest level.
- The extent of the task is to ponder the impact of PEG-4000 on quality characteristics for self-curing.

VI. DESIGN OF CONCRETE BASED ON INDIAN STANDARDS SPECIFICATION

Design stipulation: Concrete mix proportioning for M30 grade of concrete

Mix design for M30 grade of concrete

Grade designation	M30
Type of cement	OPC 53 grade
Maximum nominal size of aggregates	20mm

Minimum content of cement	320kg/m ³
Maximum water cement ratio	0.45
Specific gravity of cement	3.11
Specific gravity of coarse aggregates	2.68
Specific gravity of fine aggregates	2.583

Target Mean Strength

$$F_{ck}^1 = F_{ck} + 1.65S$$

$$= 30 + 1.65 \cdot 5$$

Calculations of cement content

Water Cement Ratio: 0.45

$$\text{Water Content: } 0.45 \cdot 320 = 144 \text{ Lit}$$

Volume of Coarse

$$\text{Aggregate} = 0.63 \text{ m}^3$$

(For Zone II Table No.3 IS 10262 – 2009)

Volume of Fine Aggregate

$$= 1 - 0.63$$

$$= 0.37 \text{ m}^3$$

6.1 PREPARATION OF CONCRETE

Creation of value cement requires meticulous consideration practiced at each phase of assembling of cement. It is fascinating realize that the element of good concrete and bad concrete are the same. On the off chance of fastidious consideration is not practiced and great standards are not watched the resultant concrete will be of bad quality. With the same material if extraordinary consideration is taken to practice control at each stage it will bring about great concrete.

6.2 Volume batching

In this technique cement, sand and concrete are batching by volume. A gage box is made with wooden plates, its volume being equivalent to that of one bag of cement. One pack of concrete has volume of 35 liters. The required measure of sand and coarse aggregates is included by measuring to the gage box. The amount of water required for making cement is found subsequent to choosing water concrete proportion. For instance, if water cement proportion is 0.45, for one bag of cement (50kg), water required is $0.45 \times 50 = 22.5 \text{ kg}$, which is equivalent to 22.5 liters. Appropriate measure is utilized to choose required amount of water. Volume batching is not perfect technique for grouping. Wet

sand has higher volume for the same weight of dry sand. It is called bulking of sand. Consequently it disturbs the ascertained volume required.

6.3 MOULDDDETAILS

SPECIMEN	DIMENSION
3D shape size	150mmx150mmx150mm
Chamber size	300mm Depth, 150mm Diameter

VII. RESULTS & DISCUSSIONS

7.1 COMPRESSIVE STRENGTH RESULTS

The compressive strength of concrete for different % weight of cement with 1.5% & 3% of shrinkage reducing admixture and super absorbent polymer (SAP) of 0.1% to 0.5% by % weight of cement were tested for 3, 7, 28, 56 & 90 days using compressive test machine. The water to cement ratio is taken as 0.45. Three cubes were casted for each proportion and the average of the three test samples were taken as the accuracy of the results. At room temperature the concrete cubes were placed for processing without curing condition. The values of crushing loads obtained are taken and the compressive strength obtained is shown.

S.NO	SAMPLE	AVERAGE COMPRESSIVE STRENGTH (N/MM ²)				
		3DAYS	7DAY S	28DAYS	56DAY S	90DAYS
1	Conventional With Curing	15.70	23.10	37.861	39.78	42.07
2	Conventional Without Curing	10.23	17.86	20.35	21.17	23.05
3	1.5% SRA & 0.1% SAP	16.35	27.72	40.20	42.11	45.20
4	1.5% SRA & 0.2% SAP	17.07	29.35	42.75	44.67	46.96
5	1.5% SRA & 0.3% SAP	15.26	26.82	39.48	41.16	43.45
6	1.5% SRA & 0.4% SAP	13.41	24.27	37.82	38.91	41.2
7	1.5% SRA & 0.5% SAP	11.05	22.192	34.26	35.35	38.46
8	3% SRA & 0.1% SAP	15.44	25.10	38.37	40.74	43.55
9	3% SRA & 0.2% SAP	16.22	27.67	40.19	42.15	45.89
10	3% SRA & 0.3% SAP	13.80	24.0	37.15	39.65	42.44
11	3% SRA & 0.4% SAP	11.45	22.80	35.56	37.37	40.52
12	3% SRA & 0.5% SAP	10.53	20.65	32.88	34.23	37.74

7.2 SPLIT TENSILE STRENGTH

Days	Processing	Average Split Tensile Strength (N/mm ²)
28 days	Conventional mix with curing	4.3
	Conventional mix without curing	2.08
	1.5% SRA & 0.1% SAP	5.02
	1.5% SRA & 0.2% SAP	5.34
	1.5% SRA & 0.3% SAP	4.945
	1.5% SRA & 0.4% SAP	4.25
	1.5% SRA & 0.5% SAP	3.82
	3% SRA & 0.1% SAP	4.72
	3% SRA & 0.2% SAP	4.92
	3% SRA & 0.3% SAP	4.17
	3% SRA & 0.4% SAP	3.7
	3% SRA & 0.5% SAP	3.54

7.3 RCPT TEST

The Rapid Chloride Permeability Test results are presented for different dosages of 1.5%, 3% SRA and 0.1% to 0.5% of SAP to the % weight of cement are added to the concrete. The results were noted for every 30 min up to 6 hours from

RCPT apparatus by summing up the readings the calculations are done by using Table 5.7 presents the chloride ion penetrability based on charge passed as per ASTM C 1202 is decided. The effects on different dosages of Shrinkage Reducing Admixture and Super Absorbent Polymer the test results of chloride permeability through Rapid Chloride Permeability Test are presented in the table

6.5.2 for different proportions of concrete. The concrete specimen tested by RCPT according to the results noted for combinations of OPC with 1.5% SRA and 0.2% of SAP to

% weight of cement showed the Moderate permeability to chloride ion permeability and at 1.5% SRA and 0.1% & 3% SRA and 0.1%, 0.2% of SAP to the % weight of cement also showed Moderate permeability to chloride ion. From test results it is observed that, at 0.1% and 0.2% of SAP to the weight of cement shows better resistance to chloride ion permeability. And the remaining proportions of 0.3%, 0.4%, and 0.5% SAP with 1.5% and 3% SRA will show the very poor resistance to chloride ion permeability.

VIII. CONCLUSION

The result of different test carried out shows the variation in mechanical strength of concrete. The following conclusions are made based on the comparative analysis of conventional concrete properties of test results by using Shrinkage Reducing Admixture and Super Absorbent Polymer in concrete test results.

1. Self-curing concrete is resulted in better hydration with time under drying condition compared to conventional concrete.

2. Self-curing concrete was the best solution to the problems faced in the desert region and faced due to lack of proper curing.
3. Performance of self-curing agent will be affected by the mix proportions mainly the cement content and the water cement ratio.
4. Using SAP was more economical in self-curing concrete than conventional cured concrete.
5. From the workability test results, it was found that by increasing the % of SRA & SAP the slump value will be increased for M30 grade of concrete.
6. The compressive strength of self-cured concrete with dosage of 1.5% SRA and 0.2% SAP is 42.75Mpa which is increased by 13% to the conventional cured concrete.
7. The split tensile strength test of self-cured cylinders for 28days is increased by 24% when compared with conventional concrete.
8. The Rapid Chloride Permeability Test were carried out for 0.1% to 0.5% SAP and 1.5%, 3% SRA to the % weight of cement. The test showed that the internal cured concrete using 0.1% and 0.2% SAP specimens were give better results to the chloride ion penetrability compared with 0.3% to 0.5% SAP.
9. There was a gradual increase in the strength for dosage of 0.1% to 0.2% SAP and then later gradually decreases for remaining dosage of 0.3% to 0.5% SAP.
10. As the percentage of Polyethylene Glycol increased to 3%, then the results were decreased for M30 grade of concrete. It gives better results for 1.5% SRA to the % weight of cement in concrete.
11. By using self-curing agent in High Strength concrete there is a significant increase in strength because of the high strength concrete has low w/c ratio. By providing self-curing agents it increases in the strength of high strength self-curing concrete than conventional cured high strength concrete.

IX. FUTURE SCOPE OF THE PROJECT

- From the results it is concluded that the compressive strength for the 0.1% & 0.2% SAP gives better results than the conventional concrete. After performing all the tests the following conclusion are derived:
 - A lot more work needs to be done before we can freely use self-curing compounds as an addition to conventional curing techniques.
 - Since the strength results are as good as compared to that achieved by conventional curing method but it needs additional research work to improve its quality and will certainly help to promote the usage of self-curing compounds in concrete.
- The workability of concrete increases with increases in the percentage of SAP & SRA.
 - This investigation was concentrated only on mechanical properties like compressive strength, split tensile test and RCPT. In addition to the fire resistance test can be performed.

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