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Review on Self Curing Concrete

Rajeswari S Unnithan[1], Sarah Anil[2]

[1]*PG Student, Department of Civil Engineering, Mar Athanasius College of Engineering, Kothamangalam*
[2]*Professor, Department of Civil Engineering, Mar Athanasius College of Engineering, Kothamangalam*

Abstract - *Now a days water is becoming a scarce material, so there is an urgent need to do research work for reducing the use of water in making concrete and its constructions. Curing of concrete is maintaining satisfactory moisture content in concrete during its early stages in order to develop the desired properties. However good curing is not always practical due to many reasons such as difficult terrain, human negligence and fluorides Therefore the need to develop self-curing agents attracted several researchers. It can perform by several methods such as using lightweight aggregate, super absorbent polymers, chemical agents or shrinkage reducing admixtures.*

***Key Words*: Self curing concrete, Polyethylene glycol, Lightweight aggregates, Super-Absorbent Polymers, Fibers**

1.INTRODUCTION

Concrete is one of the major constituent in the field of construction. It needs a proper curing and moisture contents at a minimum of 28 days for the good heat of hydration and to the desired strength. So that Properties of hardened concrete greatly influenced with the effect of curing. The traditional external curing method could not achieve desired effect due to low permeability and high chemical reactions in high performance concrete, so the researches focusing to a new method called self-curing. As defined by ACI, Self or internal curing refers to the process by which the hydration of cement occurs because of the availability of additional internal water that is not part of the mixing water.

1.1 Methods of Self Curing

The following materials can be used as internal curing agent:

- Lightweight Aggregate (Natural and Synthetic, expanded shale)
- Super-Absorbent Polymers (SAP)
- SRA (Shrinkage Reducing Admixture)

2. LITERATURE REVIEW

2.1 Self Curing Using Lightweight Aggregates

Lightweight aggregate are natural or synthetic aggregates which weighs less than or equal to 1100 kg/m^3. The most important characteristic of lightweight aggregate is its void-fraction. The high absorption values of LWA make concrete proportioning quite difficult. Expanded clay, shale and slate are the most frequently used materials of lightweight aggregate used in structural concrete. Internal curing is achieved by substituting a percentage of coarse aggregate. with light weight aggregates. These pre wetted lightweight stores water in it and act as reservoirs which release the water whenever the concrete requires. The water stored in light weight aggregates is naturally stored in pores that are bigger than the pores usually seen in a hydrating cement paste. So the water moves from light weight aggregate to the neighbouring cement paste maintaining the small pores saturated. The internal curing process utilizes cement more resourcefully throughout the hydration process. Improves the workability and reduces the cracks due to plastic, drying and thermal shrinkage. The bond between the light weight aggregate and the hydrated cement becomes continuous due to reduction in permeability and increased strength. The most important challenge linked with internal curing is how to appropriately select the accurate amount of pre-wetted LWA to add into a mixture. Several methods exist for this, from straight replacement of normal weight aggregates with LWA to more technical approaches of determining the amount of LWA. [1]

2.2 Self Curing Using Super-Absorbent Polymer

Superabsorbent polymers is a new method for prevention of self-desiccation. Most SAPs are cross-linked polyelectrolytes. Due to its ionic nature and interconnected structure, an SAP is able to absorb a significant amount of liquid from its surroundings and will retain the liquid within its structure without dissolving. Commonly SAPs are added at rate of 0–0.6 wt % of cement. They are covalently cross-linked and are Acrylamide/acrylic acid copolymers. One type of SAPs are suspension polymerized, spherical particles with an average particle size of approximately 200 mm, another type of SAP is solution polymerized and then crushed and sieved to particle sizes in the range of 125–250 mm. The size of the swollen SAP particles in the cement pastes and mortars is about three times larger due to pore fluid absorption. The swelling time depends especially on the particle size distribution of the SAP. It is seen that more than 50% swelling occurs within the first 5 min after water addition. SAP is used as a dry concrete admixture because it takes up water during the mixing process. SAP provides some degree of internally curing to concrete. SAP absorbs water and converts into gel, then releases it slowly with time. At high water cement ratio (>0.45) SAP addition has very little effect on hydration and therefore generally reduces compression strength. At low water cement ratio (<0.45) SAP addition may increases compressive strength. [2]

2.3 Self curing using chemical admixtures

Chemical admixtures reduces the evaporation of water from the surface of concrete and also helps in water retention. Shrinkage Reducing Admixture are polyethylene glycol, polyvinyl alcohol, poly-acrylic acid. Polyethylene glycol is a condensation polymer of ethylene oxide and water with the general formula $H\text{-}(OCH_2CH_2)n\text{-}OH$, where n is the average number of repeating oxy-ethylene groups typically from 4 to about 180. They are the water soluble nature. The mechanism of self-curing can be explained as follows: Continuous evaporation of moisture takes place from an exposed surface due to the difference in chemical potentials (free energy) between the vapour and liquid phases. The polymer when added to the mix mainly form hydrogen bonds with water molecules and it reduce the chemical potential of the molecules which reduces the vapour pressure and retention in physical moisture occurs. This reduces the rate of evaporation from the surface. 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 methylate or aqueous sodium hydroxide. Polyvinyl alcohol contains two OH groups. They helps to retain water from concrete and are soluble in water, slightly soluble in ethanol, but insoluble in other organic solvents. From studies it was concluded that the strength increases at different proportions of PEG i.e, 1% is optimum for M20 and M25 grade 0.5% for M40 grade. [3]

2.4 Self curing concrete with fibers

The self curing concrete is easily cracked under low tensile stress due to the weakness in resisting tensile forces. So the addition of fibre in to the concrete enhances the tensile strength, impact strength, durability, fracture toughness etc. also that will control the cracks due to both plastic and drying shrinkages. In this study Sodium Polyacrylate a water absorbent polymer was used as curing agent was added from 0.1% to 0.4% of cementatious material in concrete for M20 mix. In this study Nylon fibre of aspect ratio 25 with 0.5% by volume of fraction was kept constant. The result shows that 0.50% Nylon fibre to the concrete gives better strength to the concrete and can used as High performance self curing concrete with a mixing ratio of M20 concrete and addition of Nylon fibre to the self curing concrete improves the strength of the concrete and hence economical than conventional high performance concrete. [4]
M30 grade of concrete was produced using super absorbent polymer from 0.1% to 0.4% by weight of cement as an internal curing agent and studied the characteristics of self curing concrete with addition of 2% steel fibers by volume of concrete. The result shows that the compressive strength and workability is higher at an optimum dosage of 0.3% of Super Absorbent Polymer by weight of cement. The split tensile strength, flexural strength, shear strength and impact strength has increased with increase in various percentage dosages of addition of Super Absorbent Polymer.[5]

2.5 Water retention, hydration and moisture transport of self curing concrete

In study concrete weight loss, and internal relative humidity measurements with time were carried out, in order to evaluate the water retention of self-curing concrete and is compared to conventional concrete. The water transport through self-curing concrete is evaluated by measuring absorption%, permeable voids%, water sorptivity, and water permeability. Result shows that water retention, hydration is higher compared to conventional concrete mixes. Water transport through self-curing concrete is lower than air-cured conventional concrete and water sorptivity and water permeability values for selfcuring concrete decreased with age indicating lower permeable pores% as a result of the continuation of the cement hydration.[6]

2.6 Physical properties of self-curing concrete

In this study the effects of self-curing agents such as pre-soaked lightweight aggregate (leca) and polyethylene-glycol with different ratios on the physical properties such as volumetric water absorption, water permeability, water sorptivity and mass loss for concretes containing different cement contents of 300, 400 and 500 kg/m^3, different water–cement ratios of 0.5, 0.4 and 0.3, and silica fume ratios from 0.0% and 15% cured in dry-air during the experiments. The studies shows a significant improvement took place in the physical properties studied for self-curing concrete with poly-ethylene glycolas self-curing agent. With the addition of silica fume as an pozzolanic admixture helps in improving its physical properties and better water retention. [7]

2.7 Mechanical properties of self curing concrete

In the study for M20 grade mix light weight aggregate and polyethylene glycol is used as self curing agents. Specimen were prepared by replacing 20% of fine aggregate with that of light weight aggregate and PEG 600 at 0.5%,1%, 1.5%, 2% of cement .The strength characteristics of self curing concrete is compared with conventional concrete in the terms of compressive strength, split tensile strength and flexural strength. From results the optimum dosage of PEG is found to be 1% for M20 grade. The compressive, split tensile and flexural strength of self curing concrete is more than conventionally cured concrete.[8]

2.8 Self-curing concrete under sulfate attack

The study investigate the long-term and durability

performance of self-curing concrete compared with ordinary cured concrete subjected to sulfate attack. Here the samples are immersed in sodium sui fate Na_2S0_4 solution of 4% concentration and results were measured in terms of compressive strength, tensile strength, flexural strength and mass loss. The result shows that Sulfate resistance is improved when using self-curing concrete and by using internal curing agents also we can achieve almost 90% strength and durability achieved by normal curing method without much attention. [9]

2.9 Self-curing concrete at elevated temperatures

In the study polyethylene glycol is used as self curing agent and investigate the performance of SCC under the effect of elevated temperature for different periods. Here elevated temperature levels of 200⁰ C, 400ᵒ C and 600ᵒ C and heating periods of 2 h and 4 h as well as air and water cooling action on the compressive strength and splitting tensile strength of conventional-curing concrete and self curing concrete are studied. The result showed that the residual strength of self curing concrete is affected mainly by target temperature, heating time and cooling method. With increasing exposed period and elevated temperature the loss of strength of self curing concrete is increasing.[10]

3. CONCLUSIONS

- Self curing concrete is an effective means of eliminating autogenous shrinkage.
- Self-Curing concrete is an alternate to conventional concrete in desert regions where there is scarcity of water.
- Self curing concrete using lightweight aggregate and polyethylene glycol seems to be suitable for preparing concrete with good mechanical behavior.
- From compressive strength, splitting tensile strength and flexural strength test results, it was found that self curing concrete has more strength results than that was found in water cured concrete.
- Self cured concrete showed better hydration even under drying condition compared to conventional concrete.

REFERENCES

[1] Dayalan J, Buellah. M, "Internal Curing of Concrete Using Prewetted Light Weight Aggregates," International Journal of Innovative Research in Science, Engineering and Technology, vol. 3, 2014, 10554-10560.

[2] Abhishek Singh Deshmukh and Dr. Rajiv Chandak ,Compressive Strength Study Of Self-Curing Concrete And Conventional Concrete, Global Journal Of Engineering Science And Researches,2015

[3] M.V.Jagannadha Kumar, M. Srikanth, and K. Jagannadha Rao, Strength Characteristics Of Self-Curing Concrete, International Journal of Research in Engineering and Technology,2012

[4] Anoop KT and Sunilaa George "Strength Behavior of Nylon Fibre Concrete with Self Curing Agent", International Journal of Computer & Mathematical Sciences Vol 5, 2015,27-31..

[5] Mohammed Naseem Fairoz Kundgol, Vinayak Vijapur, "Study On Internal Curing Of Steel Fiber Reinforced Concrete Using Super Absorbent Polymer", International Research Journal of Engineering and Technology Vol 3, 2016,2395-0072.

[6] A.S. El-Dieb ,Self-curing concrete: Water retention, hydration and moisture transport, Construction and Building Materials 21 ,2007,1282–1287.

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[7] Magda I. Mousa , Mohamed G. Mahdy , Ahmed H. Abdel-Reheem and Akram Z. Yehia,,Self-Curing Concrete Types; Water Retention and Durability, Alexandria Engineering Journal, 5,2015.

[8] Remya K M, Shilpa.V S , Dhanusha.M, Ashna L Sukumar,"Experimental Study on Strength Characteristics of Self Curing Concrete using Poly Ethylene Glycol and Light Weight Aggregate", International Journal of Research in Advent Technology,2015.

[9] Bashandy,"Self-Curing Concrete Under Sulfate Attack", Journal of Polish Academy of Sciences", Vol 62,2016.

[10] Alaa A Bashandy, "Performance of self curing concrete at elevated temperatures", Indian Journal Of Engineering and Materials Sciences,Vol 22,2015,93-104.