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A Review on Self Curing Concrete

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Abstract: ***Curing of concrete maintains satisfactory moisture content in concrete in its early stages so as to develop desired properties. Self-cured concrete is one type of concrete, which cure itself by retaining water (moisture content) in it. The self-curing process of concrete takes place from inside to outside, which reduces the autogenous shrinkage and self-desiccation. It is mainly practiced in areas where there is an acute shortage of water and the application of water curing becomes costly. To overcome certain difficulties faced in curing, researchers developed a concrete called Self cured concrete. Some chemicals were used to achieve this curing. A survey of literature was done regarding the works done so far in the area of self-cured concrete. It was found out that various chemical admixtures such as Poly Ethylene Glycol (PEG), Super Absorbent Polymer (SAP), Poly Vinyl Acryl (PVA), Sodium Lignosulphonate and naturally available materials like Light Weight Aggregates, Light Expanded Clay Aggregate, wood powder and coco pith were used to produce self-cured concrete. Studies on the mechanical properties and durability of self-curing concrete were made and compared with conventional air-cured concrete, where the mechanical properties were found to be either enhanced or compromised due to the dual function of self-curing agents.***

Keywords: Self Curing concrete, Self curing agents, Mechanical properties

1. Introduction

Concrete is a mixture of cement, fine aggregate coarse aggregate and water with or without admixtures. To attain desirable strength and durability properties, curing becomes necessary. Curing is the process in which the concrete is protected from loss of moisture and kept within a reasonable temperature range. This process results in concrete with increased strength and decreased permeability. Large quantity of good quality water is needed for curing concrete and labor has to be conscious while curing. Curing is difficult when works carried out at heights. Curing can be done both internally and externally. For external curing ponding, wet covering, fogging, sprinkling, etc., can be adopted. Internal curing / self-curing can be done by adding admixtures in the concrete. In self curing concrete various additives such as poly ethylene glycol (PEG-400, PEG-600, PEG- 4000, PEG-6000), Poly vinyl acryl (PVA), Poly acryl amide (PAM), Light eight aggregates, light expanded clay aggregate, wood powder, coco pith are used to achieve effective curing results**.**

A survey had been undertaken to study the effect of using various self curing agents in producing concrete equivalent to the conventionally cured concrete and presented.

2. Poly Ethylene Glycol (PEG)

El-Dieb et al., (1) studied water retention of concrete using water-soluble polymeric glycol as self-curing agent. To evaluate the water retention of self-curing concrete weight loss and internal relative humidity measurements with time were carried out. The water transport through the concrete was analysed by measuring permeable voids percentage, water sorptivity, absorption percentage, and water permeability. The water transport through self-curing concrete is evaluated with age and compared with normal concrete. Aielstein Rozario et al., (4) presented a detailed experimental study on sulphate attack measurement on self-curing concrete with fly ash as a partial replacement of cement at ages 28 days, and 56 days, by varying polymer dosage of 0.05% and 0.1%. The increase in fly ash content decreased permeability of concrete and with the addition of P.E.G penetration of chemicals is decreased and found to be safe against sulphates. Also Mousa et al., (9) compared the water retention and durability of concrete with or without silica fume along with self-curing agents such polyethylene-glycol, and LECA with conventional concrete. The concrete mass loss and the volumetric water absorption were measured, to evaluate the water retention of the investigated concrete. Significant improvement in concrete properties due to the addition of 15% SF along with self-curing agents has been achieved, especially with 2% of Polyethylene-glycol which ensured the best results and good durability properties.

Ahmed et al.,(2) investigated the effect of using water-soluble polymers polyethylene glycol (PEG) and polyacrylamide (PAM)) as self-curing agents and found out the microstructural characteristics of Portland cement mixes with and without silica fume as cement replacement. For mixes without silica fume, the use of PEG+PAM was more effective than the use of PEG alone. Investigation of the microstructural characteristics showed a denser microstructure. The strength was increased when using PEG+PAM compared to PEG alone.

Jagannadha kumar et al.,(3) in this study used shrinkage reducing admixture called polyethylene glycol (PEG 400) They studied 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% both for M20 and M40 mixes. It was found that 1% of PEG 400 by weight of cement was optimum for M20, while 0.5 % M40 grade concrete for achieving maximum strength without compromising workability. Joseph et al., (12) who **s**tudied on self curing concrete with PEG400 for M20 grade of concrete also suggested 1% of PEG400 by weight of cement gives optimum strength for M20 grade of concrete and gets

increased the workability. Shikha Tyagi et al., (13) made M25 and M40 grade of concrete and found the optimum dosage of PEG-400 to be 1% for M25 and 0.5% for M40 grades of concrete

Mahdy et al., (6) studied the effect of partially replacing silica fume for cement and lightweight aggregate (LECA) for fine aggregate in producing self-cured concrete; Also polyethylene-glycol (PEG400) content was varied as 1%, 2%, and 3% by weight of cement so as cement content and water/cement ratio. The results show that, the use of self-curing agents in concrete effectively improved the mechanical properties. 15% LECA was the optimum ratio compared with the other ratios. The optimum usage of 2% of PEG and 15% of LECA in the concrete increases the mechanical properties. Magda et al., (5) varied different parameters constituting the self curing concrete such as LWA, PEG, cement content, water cement ratio and additives or different agents. Result showed that PEG was more effective than light weight aggregate. In all cases 2% PEG and 15% light weight aggregate gave optimum results. Higher cement content or lower water cement ratio had more effective results and adding silica fume into concrete increased strength.

Dahyabhai, et al.,(7) found the optimum amount of PEG600 for maximum effective compressive strength was found to be 1% of weight of cement for M25 grade of concrete. The optimum amount of PEG1500 of maximum compressive strength was found to be 1% of weight of cement for M25 grade of concrete. Also Sundararaman et al., (10) studied about using PEG-600 in M20 grade concrete with 0.5%,1%,1.5% and 2% variation. The result showed that the compressive strength was increased 50% and split tensile strength was increased 80% compared to conventional mix at 1.0% of PEG-600 used in concrete for all 3,7,28 days. A similar conclusion was given by Shafeeque et al., (11) from their study. Vedhasakthi et al., (8) studied the workability and strength characteristics of normal strength and high strength concrete using self-curing agents. The Strength of concrete increased significantly with the increase of self curing agent. i.e., concrete with 0.3% of PEG gives more strength than that with 0.25%. Dadaji et al.,(14) studied about self-curing self-compacting concrete using polyethylene glycol PEG4000 for dosages ranging between 0.1 to 1% by weight of cement The compressive strength of self-cured SCC are comparable with traditional cured specimens at lower w/c ratio whereas does not provide satisfactory results at higher w/c ratio. Bala Krishna et al., (26) had a comparison between normal coarse aggregate and recycled coarse aggregate which were used in self curing concrete. Here polyethylene glycol (PEG6000) was used. It was found out that the strength of recycled coarse aggregate was lower than normal coarse aggregate. Amal Viswam et al., (15) studied the effect of shrinkage reducing agents like Polyethylene-glycol and lightweight aggregates such as LECA, Silica fume. These were used to achieve effective curing results. The result showed increase in strength compared to conventional concrete while the above agents were used. Agalya et al.,(16) studied the use of shrinkage reducing admixture polyethylene glycol-PEG 400 along with steel fibers to enhance the property of concrete used. The strength parameters namely Compressive Strength, Split Tensile Strength, and Flexural Strength were determined at 7days, 14 days, and 28 days for different dosage of fiber (2%) self-curing agent (1%, 1.5%, 2%) and compared with conventional concrete.

3. Super Absorbent Polymer (SAP)

Manoj Kumar et al., (17) studied on self curing with Super absorbent polymer (SAP) as self curing agent in M40 grade of concrete. Water retention for the concrete mixes incorporating a self curing agent was higher compared to conventional concrete mixes, as found by the weight loss with time. The optimum dosage was 0.3 % of SAP, which lead to increase of Compressive strength and Split tensile strength was found in self cured concrete. Flexural strength of self cured concrete is lower than conventionally cured concrete. Performance of the self curing agent is affected by the mix proportions. There was an increase in the strength for dosage from 0.2% to 0.3 % and later reduced. Self cured concrete using SAP was more economical than conventional cured concrete. Aarthi et al., (18) study the strength behavior of adding super absorbent polymer to M30 grade of concrete. The effect of variation in adding SAP to concrete on strength properties were studied for different dosage of self-curing agent (0.1% – 0.5% weight of cement) steel fiber (1%, 1.5%, 2%) and compared with fly ash concrete. By compression test optimum percentage of SAP is found as 0.3 and steel fiber is 1.5%. But while using 2% of SAP the strength suddenly decreased. Stella Evangeline et al., (19) studied the inherent properties of self curing concrete. The super absorbent polymer (SAP) of size 200nm was used. The Polyvinyl alcohol (0.48% by the weight of cement) provides higher compressive, tensile as well as flexural strength than the strengths of conventional mix. Sona et al., (20) studied the effect of variation in strength parameters i.e., compressive strength, split tensile strength, flexural strength and durability for different dosage of self curing agent and compared with that of conventional cured concrete. The optimum dosage of SAP for maximum compressive strength, split tensile strength, flexural strength was found to be 0.5% of weight of cement for M25 and M30. Vidhuna et al., (21) investigated by adding sisal Fiber of 0.1%, 0.2%, 0.3% and 0.4% by volume of cement in Self-Curing Concrete of grade M40 with 0.3% Super absorbent Polymer. It was compared with the conventional mix. The optimum dosage of sisal fiber is 0.3% leads to a significant increase of mechanical properties .The test carried out for 28,56,90 days. Bala Subramanian et al., (22) studied the effect of super absorbent polymer by varying 0.2% to 0.4% of it in different grades of high strength concrete. In the experiment silica fume with 5%, 10% and 15% was partially replaced for cement. It was found that replacement of silica fumes by 10 % gave more strength and durability when compared to others. The optimum usage of 0.4% of SAP gives more strength.

4. Sodium Lignosulphonate

Riyaz Ahamed et al., (27) studied the effect of sodium lignosulphonate used in self-curing concrete. They varied the dosage from 0.5- 3percentage. The optimum strength was obtained at 0.5% usage of sodium lignosulphonate for M20 grade concrete.

5. Naturally Available Material As Self Curing Agent

Malathy et al., (23) did a comparative study on strength and durability properties of polymeric materials as self curing agents. Here Erukkampal at- 0.2 % to 0.4% and polyethylene at 0.2-0.4% were used as the self-curing agents. The test like 14, 28 days compressive strength, Tensile strength, and flexural strength were conducted. Strength increased 27% when using 0.2% of Erukkampal and 0.2% of PEG compared to conventional concrete

Maruthachallam et al., (24) studied the mechanical characteristics of self curing concrete using natural fiber. Here coir pith (natural fiber) was added up to 10%. Result showed that the compressive strength, split tensile and flexural strength was increased at 6% usage of coir pith. But the mean target strength was not achieved. Malathy et al., (25) studied the experimental work of self curing concrete by replacing 2% to 8%. coco pith as fine aggregate. The maximum compressive strength obtained at 28th day is 25.12 N/mm^2 for 2% replacement of coir pith. The maximum flexural strength obtained at 28th day is 3.38 N/mm^2 for 2% replacement of coir pith. The result shows that the optimum strength achieved 2% usage of coco pith.

6. Conclusions

A detailed literature review has been done on self-cured concrete. It is observed that most of the internal curing was done by adding chemical admixtures. From the literature survey done it has been found out that using 1- 2% of poly ethylene glycol (PEG) admixture in various grades of concrete gives strength equal to conventional concrete and also increases the strength up to 10-15%. When 0.3% of Super absorbent polymer (SAP) was used, the physical properties were increased to 5%. In some cases it enhanced the workability of the concrete mix also. The naturally available coir pith could be used as an alternative naturally available admixture since it has good water retention capacity and very well act as a reservoir to cure concrete internally.

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