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Materials, Mechanism and Mechanical Properties of Self-curing Concrete: A Review

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Abstract

Concrete, a key construction material with high demand for infrastructure development, necessitates an increased water input both during production and curing. This poses a challenge in areas facing acute water scarcity, highlighting the importance of research to reduce water consumption in the process. The process of hydration of the cement within concrete, without outside source, such as water for curing is referred to self curing. Improper curing will cause self desiccation, properties like autogenous shrinkage, etc. will be affected. The researchers utilized a variety of substances, including chemical admixtures, polymers, standard fibers, permeable lightweight aggregates, and pozzolanic materials, as self-curing agents. These agents possess the capacity to endure significant water exposure for extended periods. They can serve as substitutes for traditional aggregates or as infill materials. The evaluation of self-curing concrete's effectiveness involved studying durability, along with physical, mechanical, and microstructural properties., the analysis of these study and the results are reviewed and presented in this paper

Keywords: Concrete, Water scarcity, Self-curing, Admixtures, Durability, Microstructural properties

INTRODUCTION

Proper curing of structural concrete elements of structures is essential to make sure the concrete meet its intended purpose and durability requirements. This is achieved in conventional method of construction, by wetting external surface of concrete, after placing and finishing Sometimes works are to be done in places where acute shortage of water and hence proper external curing by water is not possible from economy point of view; hence loss of moisture from the surface of concrete works such as airports and highways is a challenging task for construction engineers. If the loss of moisture from concrete is not prevented properly, it may result in development of cracks due to plastic shrinkage, defective products, improper finish and other defects. So often concrete is to placed remote, tricky or far-off places where proper curing is not possible.

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The materials such as pumice, paraffin wax, crushed returned concrete aggregates, crushed waste ceramic Biomass-derived waste lightweight aggregates are used to reduce the weight, Rice husk ash, wood-derived materials In high-volume fly ash concrete used to reduce the quantity of cement. Self-curing agents such as Lightweight Expanded Clay Aggregates (LECA), Bentonite clay, perlite, diatomaceous earth, Polyethylene-glycol, zeolite aggregates, and rotary kiln expanded shale, in combination with C class fly ash, are employed for curing.

Earlier researchers have examined the performance of internally cured concrete through the assessment of factors like internal relative moisture, autogenic shrinkage, degree of hydration deformation, strain, cracking patterns, and compressive strength. This approach is applied in formulations with reduced water-to-cement ratios to achieve superior outcomes in high-performance concrete.

Material Used in Self Curing Concrete

Light Weight Expanded Clay Aggregates

LECA, an acronym for "lightweight expanded clay aggregate," is derived from expanded clay clinker subjected to furnace temperatures of up to 1200°C, as referred to by Jensen and Lura in 2006 [13]. In the development of high-performance concrete, Mousa et al. in 2015 and 2014b utilized LECA as a self-curing agent. The approach involved replacing 15% of cement with LECA, incorporating 2% polyethylene glycol based on the mass of cement, and substituting 15% of sand with LECA. Coarse aggregates were replaced by pre-wetted lightweight aggregates, with furnace-expanded clay accounting for 10%, 20%, and 30% of the 4.7-9.5 mm-sized aggregates. The water-to-cement ratio was maintained at 0.33, with a bulk density of 1050 kg/m³ and 24-hour water absorption of 12% by dry weight, as reported by Shen et al. in 2015a. Additionally, LECA with a water absorption value of 15.9% was employed as an inner curing agent, replacing 14.9% and 14.5% of sand in mortar. Class C fly ash replaced cement by 40% and 60%, and an admixture was introduced to minimize the impact on slump, as recommended by Barrett et al. 2011 [4].

Crushed Over Burnt Clay Brick

To enhance the performance of lightweight self-curing concrete, the coarse aggregate was substituted with crushed overburnt clay brick at proportions of 20%, 50%, and 100% (Rashwan et al., 2016) [5]. Coarse aggregates passing through a 40 mm sieve and retained on a 25 mm sieve were utilized, maintaining a water/cement ratio of 0.48. Selected for its larger pores in comparison to cement, this material served as a self-curing agent, allowing the water stored in these pores to migrate to the smaller pores of the cement, promoting early-stage hydration. The water absorption capacity was reported as 13.25% by weight. The rough surface of the crushed overburnt clay brick facilitates a strong bond with cement. Assessing the concrete's durability, the pH value of this material was determined to be 8.5, indicating a non-acidic nature.

Paraffin Wax

Paraffin was incorporated into concrete, either in its solid or liquid form, as an external agent at varying percentages (0%, 0.1%, 1%, and 2% by weight of cement) with water/cement ratios of 0.35 and 0.45, as indicated in studies by Chand et al. (2014) [6] and Reddy and Reddy (2016) [7]. Paraffin wax, a colorless soft solid or white material derived from petroleum products, coal, or oil shale, is a combination of hydrocarbon molecules containing approximately 20-40 carbon atoms. Solid at room temperature, it begins to melt at temperatures exceeding approximately 37°C (99°F). In applications involving higher-grade concrete, it proved effective in liquid form at lower dosages, while in solid form, it was suitable for lower-grade concrete. However, excessive dosages in its soft solid state were found to be less effective, whereas lower doses were optimal for creating a seal against water, thereby resisting moisture loss through evaporation from the concrete.

Polyethylene-glycol (PEG-400)

Paraffin, whether in solid or liquid form, was introduced into concrete as an external agent at varying concentrations. This self-curing agent, as outlined by Mousa et al. (2015) [1], possesses a chemical nature. Polyethylene glycol (PEG) is employed at 0.2% of the cement mass, as reported by Ankith (2015) [8]. Additionally, Junaid et al. (2015) [9] utilized it at 1% of the cement weight, and Mousa et al. (2014a) [10] at 3% of the cement mass, across different water-to-cement ratios (Rampradheep and Sivaraja, 2016) [11]. PEG, characterized as harmless, odorless, inert, non-volatile, non-irritating, and lubricating, functions by reducing the surface tension of water, thereby mitigating water/moisture loss

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from concrete due to evaporation (Mousa et al., 2014b) [2]. Its full solubility in water, superior molecular weight compared to water, and composition containing hydrogen and oxygen compounds, along with hydroxyl and ether functional groups, render it suitable as a self-curing agent. PEG contributes to preserving moisture in concrete for effective curing.

Pumice

This is a natural lookslike a sponge; lightweight aggregate that formed at the time of rapid cooling and solidification of molten lava; (Zhutovsky et al., 2002b) [12] have studied the water absorption capacity of three types of various sizes where as type 1 with 0.15 mm<d<1.18 mm size while rate of absorption of 13.0% by mass and 17.3% by quantity, the type 2 with 1.18 mm < d < 2.36 mm size and rate of absorption of 19.0% by mass and 24.9% by cubic measure and the last type with 2.36 mm < d < 4.75 mm size and rate of absorption of 26.7% by mass and 32.3% by volume. Aggregates of It can be used as self-curing agent, owing to its variations in dimension and superior water absorption capacity that compensates the concrete curing.

One of the polymer materials exhibiting water absorption capacity is SAP, as noted by Jensen and Lura in 2006 [13]. SAP, a compressed cross-linked crystalline sodium salt of polypromancic acid, possesses a remarkable 2,000 times water absorption capability when exposed to uncontaminated water. To facilitate its application and prevent gel clumping during the initial stage of hydration, SAP is combined with blast furnace slag and ground silica coating. The un-hydrated polymer particles have an angular shape and range in size from 50 to 300 mm. Upon the commencement of SAP hydration, it undergoes swelling, releasing the stored water; thereafter, it becomes inactive and unable to rehydrate. During the preparation of fresh concrete, SAP is added in a dry state, and additional water is introduced during mixing to allow absorption. For pervious concrete, SAP is utilized at a rate of 0.375% by the mass of the cement, following the recommendations of Kevern and Farney in 2012 [14], as well as Jensen and Hansen in 2001.

Distinct researchers have employed a variety of materials as self-curing agents in their studies. In the work of Chand et al. (2014) [6], Paraffin wax was utilized, while Kim and Bentz (2008) [15] incorporated crushed returned concrete aggregates and crushed ceramic waste, both of which demonstrated enhanced effects on concrete as self-curing agents. Rice husk ash was chosen by Rößler et al. (2014) [16] opted for materials derived from timber for the self-curing process. Additionally, PEG was applied in different proportions by mass of cement, leading to improved concrete properties in the studies conducted by Mousa et al. (2014b, 2014a, 2015) [1, 10, 2]. Furthermore, Ghourchian et al. (2013) [17] used Zeolite aggregates in their research. This diverse range of materials showcases the varied approaches researchers have taken in exploring self-curing agents, contributing to the advancement of concrete technology.

Rashwan et al. (2016) [5] introduced over-burnt compressed clay brick as a substitute for sand, serving as a drenched lightweight aggregate. This replacement aimed to enhance the performance of the internal curing component. Additionally, Geiker et al. (2004) [18] proposed substituting sand with waterlogged lightweight aggregates to further improve curing. The application of self-curing techniques was implemented in the field of transportation by the Rashwan et al. (2016) [5] team, specifically targeting the reduction of early-age concrete pavement cracks. Notably, a substantial volume exceeding 420 m^3 of self-cured concrete was successfully employed in the construction of State Highway 121 in Texas (Friggle and Reeves, 2008) [19]. In the Dallas-Fort Worth area, Villarreal and Crocker (2007) [20] utilized normal density self-cured concrete for various structures.

Mechanism of Self-Curing Concrete

Chemical shrinkage occurs during cement hydration, resulting in the formation of empty pores and a decline in relative humidity. This leads to self-desiccation and a lack of moisture in the cement paste, resulting in the formation of voids and micro-fracture cracks, which act as weak points in the cement matrix. Self-curing is employed to maintain relative humidity and prevent self-desiccation. Traditional curing involves external methods to keep the concrete warm and moist, allowing continuous cement hydration until the concrete attains its full strength (Taylor, 2013) [21]. The introduction of self-curing aims to address self-dehydration throughout the concrete. Improper curing occurs in areas with water scarcity or when the curing process is mismanaged, leading to inadequate long-term curing of structures. Self-curing involves incorporating small amounts of chemicals into the concrete during mixing to retain water up to the required point for concrete setting. Sustaining moisture in concrete is crucial, especially when the hydration efficiency is low and relative humidity falls below 80%, as noted by Junaid et al. (2015) [9]

The absence of sufficient water in concrete can impede the hydration process, preventing the attainment of desired properties. In recent years, a novel approach to address this issue is through internal-cured concrete, aiming to maintain the necessary moisture for enhanced strength and durability (Babcock and Taylor, 2015) [22]. The key components of self-cured concrete include cement, fine aggregate, coarse aggregate, a self-curing agent, and water, all incorporated during the mixing process. The principle behind internal curing involves the provision of water from internal sources, such as aggregates or polymers with a significant water-absorbing capacity during mixing. This concept aims to counteract the evaporation of water from the concrete, thereby enhancing the concrete's water storage capacity compared to conventionally water-cured concrete..

(Dhir *et al*., 1998) [23]. (Kovler, 2012b) [24] have abridged the concrete curing method that describes the difference between method of outside curing and inside curing clearly like shown in Figure 1. The Self-curing agents stretch the water all over cross-sectional area for curing while the curing from outside can pierce to few millimetres only (De la V *et al*., 2012) [25]. Difference between exterior cured and inside cured was described in Figure 2.

Relative humidity present in concrete plays very important role in self-curing of concrete since; when the relative moisture is more than 96%; the majority of the water is released from lightweight aggregate as shown in Figure 1

Methods of Self Curing Concrete

The existing literature indicates that lightweight fine aggregate outperforms lightweight coarse aggregates (Cleary and Delatte, 2008) [26]. The underlying principle of interior curing using Lightweight Aggregate (LWA) is that the initial water loss occurs from the largest pores. Generally, the voids in LWA are larger than those in the surrounding cement paste (de Sensale and Goncalves, 2014) [27]. As the voids in the paste decrease in size during hydration, the hydrated paste effectively extracts water. Following hydration, this leads to a water deficiency in the cement paste, establishing a moisture gradient. Water is initially transported from the LWA through capillary action, followed by vapor diffusion. Subsequently, capillary compression initiates from the LWA to the cement paste, promoting continuous hydration. Optimal efficiency of the agent is achieved by employing materials with smaller dimensions and high porosity, ensuring uniform distribution in concrete (Zhutovsky et al., 2004) [28].

Methods of Utilizing Self-Curing Agents in Concrete

The researchers incorporated the self-curing agent in an alternative manner, as indicated by Henkensiefken et al. (2010) [29]. Before mixing, lightweight aggregates (LWA) were dried in an oven at 105°C following the method outlined by Mousa et al. (2014b). After cooling in air, the aggregates were immersed in water for 24 hours to account for both water added during mixing and absorbed water. The excess water was stored separately for subsequent use in concrete. A similar approach was adopted for lightweight expanded clay aggregate (LECA), with the self-curing agent mixed with water according to the methods described by Mousa et al. (2014a) and Barrett et al. (2011) [4]. To maintain moisture, the lightweight aggregate was placed in a synthetic container for 7 days, after which the water was drained following the procedure.

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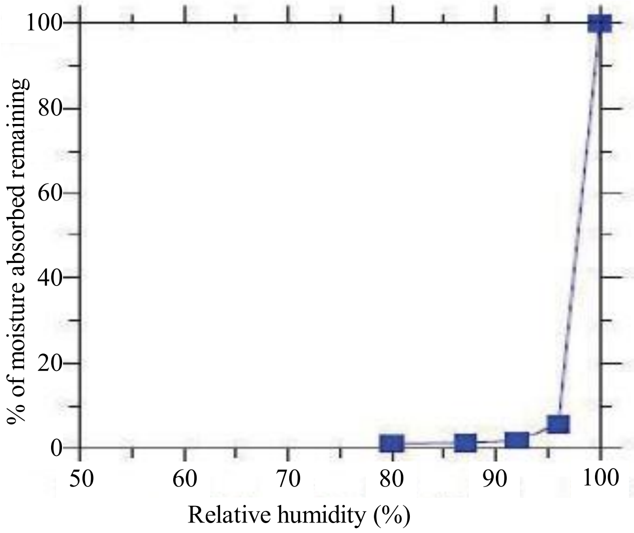

Figure 1. Desorption feature of lightweight aggregates.

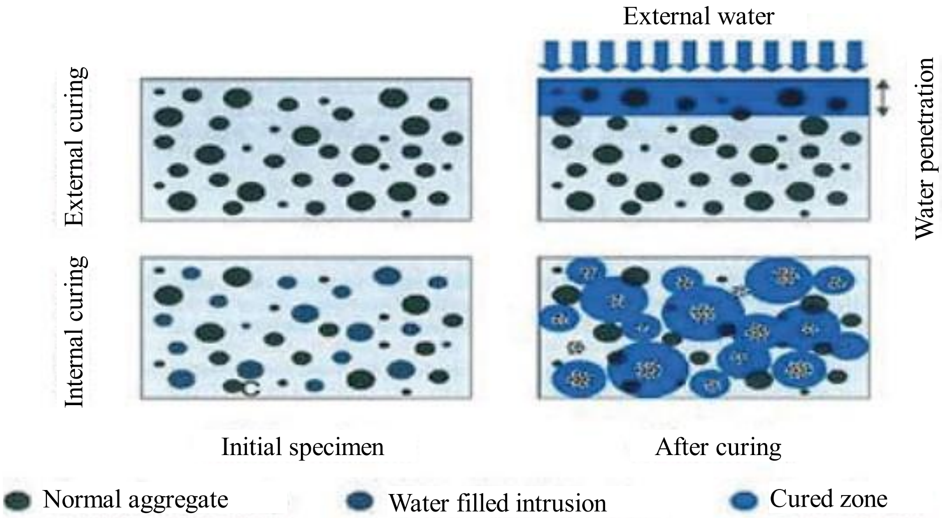

Figure 2. System of self curing.

RESULTS AND DISCUSSIONS

Bentur et al. (2001) [30] substituted 10% of cement with silica and replaced the normal weight aggregate with 25% LECA under saturated surface dry conditions. They examined the shrinkage of self-cured concrete and found that the inclusion of lightweight aggregate initially led to concrete expansion due to water contribution from LWA, subsequently eliminating autogenous shrinkage. Zhutovsky et al. (2002a) [31] introduced pumice as an internal curing agent in dimensions ranging from 0.15 mm < d < 1.18 mm, 1.18 mm < d < 2.36 mm, and 2.36 mm < d < 4.75 mm, with a w/c ratio of 0.33. They replaced fine aggregate at various percentages of 10, 20, and 30, and assessed the impact of dimensions on the strength properties of self-curing concrete. Test results indicated that, among the three dimensions, 2.36 mm < d < 4.75 mm exhibited enhanced properties.

Bala Subramanian et al. (2015) [32] conducted experiments to investigate the strength of self-curing concrete using polyethylene glycol (PEG 400) at concentrations of 0.2%, 0.3%, and 0.4% by weight of cement. High-strength concrete with grades M 60, M 70, and M 80 was achieved by incorporating silica fume (SF) as a mineral admixture, replacing cement in varying proportions of 5%, 10%, and 15%. The desired workability was attained through the addition of the chemical admixture Glenium B233, with the optimal superplasticizer dosage determined by the Marsh Cone test.

Two sets of specimens were cast: one conventionally cured and the other subjected to self-curing methods. The specimens underwent testing to evaluate compression stress, tensile strength, flexural strength, Rapid Chloride Permeability Test (RCPT), and water sorptivity. Analysis and comparison of the test results revealed that the required strength and RCPT values were achieved using polyethylene glycol. The study reported an enhancement in workability with the use of the self-curing agent. Substituting 10% of cement with silica fume led to improved strength, while a 15% replacement resulted in a decrease in Rapid Chloride Permeability. The strength was significantly enhanced with increased concentrations of the self-curing agent. Specifically, concrete with 0.4% PEG exhibited superior strength compared to concrete with 0.2% and 0.3% PEG.

has investigated the HPC with mix proportions of cement: sand: coarse aggregate ratio as 1:2:2 having 0.34 water/cement ratio and controlling the creep and shrinkage subjected to inside curing. Internal cured conventional HPC with the same ratio but sand replaced with pre wetted saturated lightweight aggregates in different values of 6 and 20%. It was reported that using saturated lightweight aggregate in concrete didn't exhibit significant effect on the properties like air content and slump of fresh concrete. Improved results of autogenous shrinkage, to begin with it was extended but afterwards it was maintained equal when Sand was replaced with 20% soaked lightweight aggregates. Similar tendency was observed in restrained shrinkage. Replacing sand with 20% of saturated lightweight aggregate diminish the danger of formation of cracks in concrete owing to the diminish in strength of concrete in tension.

In 2013, M. Manoj Kumar [33] conducted a study exploring the mechanical properties of M40 grade concrete. They utilized superabsorbent polymer (SAP) and a wax-based polymer membrane curing compound as self-curing agents on demoulded specimens. The investigation assessed compression strength, split tension strength, and flexural strength at 3, 7, and 28 days, employing varying dosages (0.2%, 0.3%, and 0.4% by weight of cement) of the self-curing agent. The results were compared with conventionally cured concrete specimens. The findings indicated that the water retention in concrete with self-curing agents surpassed that of conventionally cured concrete, as evidenced by the observed loss of weight over time. Internally cured concrete specimens using SAP demonstrated higher compression strength values across different proportions (0.1%–0.6%) compared to conventionally cured counterparts. Split cylinder tests revealed a 6% increase in strength for membrane-cured concrete specimens compared to conventionally cured ones. The optimal SAP dosage for internal curing was reported to be 0.3% by weight of cement. Flexural strength results indicated that self-cured concrete with a 0.3% quantity exhibited lower strength than normal water-cured concrete. However, strength improved gradually with increasing quantity from 0.2% to 0.3%, followed by a gradual decrease. The impact of the self-curing agent was influenced by mix proportions, particularly the cement quantity and water-to-cement ratios. The study concluded that concrete with self-curing using SAP proves to be more effective and cost-efficient than conventionally water-cured concrete.

Sachin Julian Francis, Karthik B., Gokulram H., 2017 [34] studied the strength in compression, strength in split tension for self cured concrete with various quantities of polyethylene glycol and the test results be compared to that of usual normally cured concrete specimens. In this study; O.P.C. of 53 grade, passing 20 mm sieve and reserved in 4.75 mm sieve coarse aggregate and lightweight fine aggregate of various quantities of 0, 10, 20, 30, 40 and 50% and the optimal quantity was established as 25% was used as the fine aggregate. The cubes and cylinders were cast in M30 grade the fine aggregate replaced with 25% of lightweight aggregate, with high water absorption and with various quantities of 0.5, 1, 1.5 and 2% of polymeric glycol and the specimens were tested to study the mechanical properties at an age of 7 and 28 days. It was concluded that with increase of the lightweight aggregate percentage; the value of slump decreased whereas the value of slump improved with increase in the of PEG400 and the optimum percentage of polyethylene glycol was found to be 1%.

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In their 2008 study,[26] Cleary and Delatte explored the durability and mechanical characteristics of self-cured concrete. They replaced regular weight coarse aggregate with lightweight coarse aggregate

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and determined that the strength properties improved, with no visible cracks. Furthermore, the durability properties showed superior results compared to water-cured concrete utilizing lightweight coarse aggregate.

In Suzuki et al.'s (2009) [35] study, normal weight aggregates were systematically replaced in increments of 10%, ranging from 10% to 40%. Simultaneously, cement was substituted with silica fume at a fixed rate of 10%, maintaining a constant water-to-binder (w/b) proportion of 0.15. Polycarboxylate served as the superplasticizer. The investigation focused on elastic modulus, cement hydration, shrinkage, and compressive strength. The findings indicated that the use of PCCA led to enhanced cement hydration and strength. However, it also resulted in diminished values for autogenous shrinkage, internal stress, and elastic modulus.

Zhutovsky and Kovler (2012) [36] investigated the impact of self-curing on the durability of High-Performance Concrete (HPC). Their findings revealed that substituting fine aggregate with pumice in the size range of 2.36 mm to 4.75 mm, at varying water-to-cement ratios (w/c) of 0.21, 0.25, and 0.33, while employing a superplasticizer (calcium naphthalene sulfonate) to maintain slump between 11.0 cm and 16.0 cm, led to notable outcomes. The study observed a decrease in autogenous shrinkage, elastic modulus, air permeability, and chloride ion penetration, while sorptivity and loss of mass values increased due to increased porosity.

In their 2012 study, Kevern and Farney [14] explored the reduction of necessary curing time for pervious concrete by incorporating 0.375% superabsorbent polymer (SAP) based on the mass of cement. According to their findings, the utilization of SAP led to increased strengths and density, reduced voids and shrinkage in self-cured concrete. Notably, the loss of moisture and durability properties remained relatively consistent between normal-cured and self-cured concrete.

(Rößler et al., 2014) [16] investigated the slump, shrinkage, and compressive strength of four different mixes of High-Performance Concrete (HPC). The first mix exclusively utilized rice husk ash, while the second mix incorporated silica fume. The third mix combined rice husk ash with Ground Granulated Blast Furnace Slag (GGBS), and the fourth mix integrated silica fume with GGBS. In all mixes, the quantities of silica fume and rice husk ash remained constant. Test results indicated that the addition of GGBS to mixes with silica fume and rice husk ash led to an increase in slump values. The mix containing GGBS and rice husk ash demonstrated the highest compressive strength among the four mixes. Ultra-high-performance concrete with silica fume exhibited greater shrinkage compared to concrete with rice husk ash, attributed to the heightened degree of hydration acceleration in mixes with silica fume. The addition of GGBS reduced shrinkage, with a more pronounced effect observed when rice husk ash was included. In ultrahigh-performance concrete mixes with silica fume, relative moisture decreased, while mixes with rice husk ash showed elevated relative humidity due to water present in the voids of rice husk ash.

Mousa et al. (2014b), Mousa et al. (2014a), and Mousa et al. (2015) [1,10,2] conducted a comprehensive examination of the physical, durability, and mechanical characteristics of internally cured concrete. In their investigations, they replaced 15% of the cement with silica fume, incorporated 0 to 20% pre-saturated lightweight aggregates (LECA) at 15%, and introduced 1 to 3% polyethylene glycol. The findings indicated that a combination of 15% silica fume, LECA at 2%, and 2% polyethylene glycol yielded superior results across all studied properties. Notably, polyethylene glycol contributed to a reduction in water loss, LECA served as an effective internal curing agent by supplying water as needed, and silica fume slowed down the hydration process.

Mousa *et al.* have investigated the mechanical properties of concrete selecting two materials, pre-soaked lightweight aggregate (Leca) in various quantities of 0.0, 10, 15, and 20% of sand; or various quantities of 1, 2 and 3% of PEG by mass of the cement as self-curing agents and adding silica fume.

The study was carried out with various quantities of cement of 300, 400 and 500 kg/m^3; different water/cement proportions of 0.3, 0.4 and 0.5 and silica fume of 0.0 and 15% by mass of cement as an admixture. The specimens were subjected to air curing (at the room temperature in the laboratory with 25ºC and 65% R.H.) and studied the mechanical properties. From the test results it was reported that the mechanical properties have been improved considerably by using self-curing agents. The specimens with polyethylene-glycol as self-curing agent, exhibited high values of the mechanical properties compared to that of concrete with soaked Leca. It was reported for all the specimens of different mixes, either 2% of PEG /15% Leca was the most favourable value of ratio compared to other values. The specimens with more cement and/or less value of w/c proportions exhibited more effective performance of the self-curing agents. By adding silica fume to self-curing concrete; the mechanical properties have been enhanced, owing to its pozzolanic reaction, as well as owing to its capability to maintain water within concrete.

Shen et al. (2015a) [3] investigated the influence of pre-wetted lightweight aggregates on the heat and cracking tendencies of self-curing High-Performance Concrete (HPC). They replaced coarse aggregate with lightweight aggregate at a water-to-cement (w/c) ratio of 0.33, using rotary kiln expanded clay at varying percentages (10% to 50% in 10% intervals) in the size range of 4.75 mm to 9.5 mm. The findings indicated that an increase in pre-soaked lightweight aggregates in the concrete led to a rise in temperature. This was attributed to the abundant water in the lightweight aggregate, accelerating hydration levels, inducing stress, and reducing the age at which concrete typically cracks. Furthermore, Shen et al. (2015b) [37] examined the impact of internal relative humidity (IRH) during the early stages of HPC, incorporating super absorbent polymers (SAP) as internal curing agents. Self-desiccation in HPC, resulting from lower water/cement ratios, led to reduced relative moisture and subsequent shrinkage. This issue was addressed by adding SAP at varying percentages (5%, 10%, 15%, and 20% by mass of cement) while maintaining a constant w/c ratio of 0.33. Internal relative humidity was measured using a digital sensor. The conclusion drawn was that the addition of SAP increased the internal relative humidity within the concrete, extending the duration of self-desiccation compared to conventional water curing methods.

Rashwan et al., 2016) [5] have studied the strength properties of self-cured light weight concrete at age of 28 days replacing 20, 50 and 100% by volume of coarse aggregates with crushed over burnt clay bricks (COBCB) and maintaining constant water to cement ratio at 0.48. The specimens were cured by three methods, (1) conventional curing, (2) ambient curing and (3) chemical curing by painting samples with kerosene oil for curing of test specimens. It was reported that replacing 20% of COBCB causes improvement in the compressive strength and 28 days for all the three types of curing. Improvement of the results attribute to the enhanced hydration resulted from the presence of sufficient water in COBCB. The replacement of 20% above exhibits inferior values of mechanical properties.

In their 2016 study, [5] Rashwan et al. examined the strength characteristics of self-cured lightweight concrete after 28 days, wherein 20%, 50%, and 100% of coarse aggregates were replaced by volume with crushed overburnt clay bricks (COBCB). The water-to-cement ratio was maintained at a constant 0.48. Three curing methods were employed: (1) conventional curing, (2) ambient curing, and (3) chemical curing involving the application of kerosene oil on test specimens. The findings indicated that substituting 20% of COBCB led to an enhancement in compressive strength after 28 days across all three curing methods. This improvement was attributed to increased hydration resulting from the ample water content in COBCB. However, replacing more than 20% showed diminished mechanical properties.

CONCLUSIONS

After reviewing the existing literature on self-curing concrete, it is evident that previous researchers have employed self-curing agents, including artificial, natural, recycled, or chemical agents.

Availability issues arise with natural and recycled aggregates, which may not be consistently accessible in large quantities. Artificially manufactured aggregates are not environmentally friendly, and chemical agents pose safety concerns and time constraints. Consequently, both safe and eco friendly materials without effecting economy are required.. Conventional concrete typically relies on ample water for hydration, but in remote or elevated areas like hills where water availability is limited, or in hot climates, traditional curing becomes challenging. In such scenarios, the loss of water from concrete due to climatic conditions impedes proper hydration, resulting in inferior concrete quality and failure to achieve the required strength. Hence to resolve this problem the investigations have made use of the idea of system of self-curing. In the earlier investigations the centre of attention is to resolve the shrinkage problem, but owing to desertion of water from concrete shrinkage occur; the concrete surface quality becomes poor; so investigations are essential to arrive at the best quality of concrete with good finish with self curing mechanism.

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