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A REVIEW ON SELF-CURING CONCRETE USING DIFFERENT SUBSTITUTES MATERIALS

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Abstract

A revolutionary development in terms of building materials and procedures is self-curing concrete. This abstract offers a succinct review of the main features and relevance of self-curing concrete, emphasizing its workings, advantages, and effects on the building sector.

Self-curing concrete is a revolutionary method that uses less water, produces concrete of higher quality, and speeds up building. It does away with the necessity for conventional curing techniques by utilizing internal moisture-retaining systems or cutting-edge additives, having positive effects on both the economy and the environment. The processes of self-curing are explored in this abstract, with a focus on how it may be used to solve enduring problems like durability, strength growth, and surface cracking.

This abstract highlights the benefits of self-curing concrete, including increased structural integrity, decreased labor needs, and sustainability, through a comprehensive examination of current research and real-world applications. Additionally, it talks about self-curing technologies' shortcomings and incorporation into actual building projects.

The abstract ends by outlining current research initiatives and the excellent prospects for self-curing concrete in the building sector. Self-curing concrete is positioned to play a significant role in influencing the future of building processes across the world as a cutting-edge technology that improves efficiency, quality, and sustainability.

Keywords: Spinacea pleracea, Calatropis gigantean, LECA, Interfacial Transition Zone(ITZ)

Introduction

Modern building relies heavily on concrete, which is prized for its adaptability, toughness, and longevity. Curing, however, is a crucial step that is frequently missed in concrete constructions in order to get the appropriate qualities. To guarantee the hydration of the cement particles and the formation of the requisite strength and durability, freshly laid concrete must be kept at an appropriate temperature and moisture level throughout curing.

In the past, hand curing techniques like wet curing (sprinkling or ponding water) or the application of curing agents and membranes have been the norm. These techniques can be time-consuming, expensive, and prone to errors, even if they can be beneficial when carried out precisely. The success of the curing process is also influenced by variables like the weather, which might provide uncertainties and difficulties during building.

Self-curing concrete has become a notable invention in the building sector as a result of these restrictions. By adding moisture-retaining mechanisms directly into the concrete mix or by leveraging cutting-edge additives and technology, self-curing concrete is intended to overcome these problems. This invention is revolutionizing how we approach curing in construction and has a number of advantages that go beyond the actual curing process.

This overview prepares the reader for a thorough investigation of self-curing concrete. We will explore the mechanics underlying self-curing, the benefits it offers, its practical uses, and its potential to transform building techniques. We will learn the significance of self-curing concrete as we explore its universe and learn how it may improve the effectiveness, quality, and sustainability of building projects.

Mechanism of self curing

Innovative techniques and technologies are used to maintain acceptable moisture levels in the concrete mixture during the initial phases of curing as part of the processes of self-curing in concrete. The complete hydration of cement particles and the creation of the necessary strength and durability of concrete depend on this moisture retention. The following are some of the main systems and tools employed in self-curing concrete:

- Internal Water Reservoirs: Internal reservoirs that release water progressively over time can be included in self-curing concrete. These reservoirs can be lightweight aggregates, pre-soaked fibers, or porous lightweight materials included into the concrete mix, among other things. These reservoirs release moisture as the concrete dries, maintaining a constant curing environment.
- Superabsorbent Polymers: SAPs are hydrophilic polymers with a high water absorption and retention capacity. When SAPs are included in the concrete mix, they collect water while it is being mixed and then slowly release it as the concrete dries. This keeps the required moisture levels in check and lessens the likelihood of surface cracking and drying shrinkage.
- Hydrogels: Significant volumes of water may be absorbed and retained by hydrogels. Hydrogels can be added to concrete to help it self-cure by absorbing extra water during the mixing process and gradually releasing it throughout the curing phase. They could take the shape of powder, granules, or things that resemble gel.
- Moisture retaining Admixtures: To improve the water-retaining capabilities of concrete, certain chemical admixtures are used. These additives alter the concrete's pore structure, lowering water evaporation and enhancing moisture retention. They may be especially useful in hot, dry conditions.
- Encapsulation Technology: In certain instances, self-curing processes enclose moisture-retaining substances or water within microcapsules. As the concrete dries, these capsules burst apart, gradually releasing moisture into the adjacent concrete matrix.
- Permeable Shuttering/Formwork: When permeable formwork or shuttering is used to surround concrete, the formwork may absorb and hold onto water, which is then gradually released into the concrete. This technique is frequently used to self-cure concrete precast pieces.
- Spraying and Fogging systems: Self-curing may be accomplished in some construction applications by installing automated fogging or spraying systems that regularly mist the

concrete surface with water. By doing this, moisture levels are maintained automatically.

These processes enable the concrete to self-cure by operating together or separately. They are intended to lessen reliance on conventional curing techniques, which may be labor-intensive and inconsistent, including wet curing or the use of curing agents. Self-curing concrete can improve concrete quality, decrease cracking, and increase durability by maintaining ideal moisture levels, especially in situations where it may be difficult to efficiently use conventional curing techniques.

Literature Review

The use of polyethylene glycol in self-curing concrete to enhance its mechanical qualities while air curing was the subject of research by Mohammad Abid and Khushpreet Singh. When compared to controlled concrete, this chemical additive increases the cement paste's binding force with aggregate while decreasing pores and voids. The ideal percentages for self-curing concrete are 0.5% polypropylene fiber and 15% waste marble powder. Cement and marble powder generate stronger binding forces, but the combination of discarded marble powder and PP-fiber improves the hardened properties of concrete. Self-curing concrete's compressive strength is boosted by 41.13 MPa for 28 days while the material's flexural and split tensile strengths are improved. PEG-400 decreases sand extraction and saves 2 to 3 m3 of water for every 1 m3 of concrete. In self-cured concrete samples, SEM photos reveal weak ITZ and fractures, while XRD measurements reveal that D3 has the greatest SiO2 intensity value when compared to controlled concrete.

Self-curing concrete is a solution to problems with a shortage of curing water, according to BL Niranjan Reddy and M Vinod Kumar. In dry situations, it hydrates more effectively than conventional concrete. When used as a chemical additive, adding 1-2% of poly ethylene glycol (PEG) raises slump value and enhances strength by up to 8-15% compared to regular concrete. Concrete that cures on its own lowers autogenous shrinkage. The ideal strength and durability is achieved using a mixture of 0.48% Poly vinyl alcohol (PVA) and 1% Sodium Lignosulphonate (SL). Plant-based materials with superior mechanical qualities include Spinacea pleracea and Calatropis gigantean. LECA promotes workability while reducing compressive and flexural strength. To enhance the characteristics of concrete, additional chemical admixtures can be used.

The effect of curing techniques on the compressive strength of sustainable self-consolidating concrete samples was studied by Osama Mohamed and Omar Najm. Fly ash, silica fume, GGBS, and 90% recycled cement made up the mixture. The mixes attained standard cube compressive strengths of 70 MPa and 76 MPa, respectively, with a w/b ratio of 0.36 and 0.33, respectively. Portland cement was replaced with 72.5% or 70% slag and 12.5% or 15% silica fume in high-performing mixtures. The findings demonstrated that, as compared to employing a curing agent or conventional techniques, curing under direct sunlight produced the maximum strength development after 28 days. Additionally, greater strength growth was obtained when an acrylic-based curing chemical was used. This suggests that curing compounds are advisable in water-scarce environments or for water conservation purposes.

Researchers Manvendra Verma and Mayank Nigam found that self-curing concrete with 1%

PEG4000 had more strength than a traditional specimen with M40. From seven days, the compressive strength rose by 8.27%, the splitting tensile strength by 17.28%, the 28-day strength by 1.45%, and the 28-day strength by 22.22%. However, the flexural tensile strength declined from seven to 28 days by 37.57% and 45.65%, respectively, with 1% PEG4000 exhibiting a loss of 37.57% and 45.65%. This suggests that a specimen containing 1% PEG4000 is stronger than a standard specimen containing M40.

In contrast to normal concrete, the PEG-400 solution produced 25% greater compressive strength, 30% higher flexural strength, and 70% higher split tensile strength, according to V Kastro Kiran's analysis. However, when exposed to salts like NaCl and CaCl2, self-cured concrete loses strength. This is mostly because salt compounds are present in the solution. Despite this, self-cured concrete is still a viable option for the foreseeable future.

Researchers Bashandy A. A., Safan M. A., and Ellyien M. M. examined the durability of self-curing concrete made using recycled aggregate and came to the conclusion that dolomite aggregate demonstrates more durability than crushed concrete and crushed brick aggregate. Under sulfates, the compressive, tensile splitting, and flexure strength values rise but fall after six months. Under chlorides, the bond strength values of reinforced RA-SC concrete diminish with time.

Under chloride assault, self-curing concrete beams early cracking and ultimate loads are reduced. Corrosion at the steel reinforcing bars reduces the flexural strength of reinforced concrete beams. Under chlorides, the ductility values of reinforced concrete beams rise, however DC beams are less ductile than CC and BC beams. As the ductility ratio rises, the stiffness of DC beams reduces along with the elastic modulus values. With time, the toughness modulus decreases, with DC beams having greater toughness than CC and BC beams.

In self-curing concrete, recycled aggregates with acceptable durability properties against chloride and sulfate assaults include crushed concrete and crushed red bricks. For self-curing concrete, the following coarse aggregates can be used: dolomite, crushed concrete, and crushed red bricks. This technique conserves natural resources and lessens its impact on the environment. Concrete's water retention capacity is increased when chemical curing agents like PEG 400 are employed to decrease water evaporation from the concrete.

Conclusion

Compared to regular concrete, PEG-400 solution improves the compressive strength, flexural strength, and split tensile strength of concrete. Strength and slump value are increased by 8–15% by adding 1–2% PEG. Concrete that is self-curing and contains 1% PEG4000 is stronger than M40. Under chloride attack, PEG 400 lowers ultimate loads and early cracking. By reducing water evaporation, it improves water retention capacity. 15% leftover marble powder and 0.5% polypropylene fiber are the optimal amounts for self-curing concrete.

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