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Experimental investigation on Self-Curing Concrete incorporated with Polyethylene glycol and Rice Husk Ash Powder

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Abstract*: The necessity of concrete is increasing year by year. In present, cement is now becoming a non-renewable material because of lack of limestone deposits. Also, while the production of cement (OPC) a lot of CO2 emission causes to global warming and air pollution. Even though Water curing is the most effective curing method to promote continuous hydration of cement and cement supplementary material in concrete. In practice, this ideal curing condition is provided for a limited period in concrete construction. Hence, Self-curing concrete is relatively a new chemical admixture to improve the water retention in concrete. The project work discusses the expected result of an experimental investigation into the evaluation of a concrete mix with replacement of cement by Rice Husk Ash with 5%, 15%, 20% and PEG-400 is to be taken 1.0% on M30 Mix. It is expected that a self-curing admixture will be a useful ingredient in concrete mixes and will increase the workability of concrete mix. Also, it is expected that use of this combination i.e., Rice Husk Ash and PEG-400 will eliminate the errors in conventional curing and overall economy will be achieve.*

Keywords: Self-curing Concrete, Rice Husk Ash, Polyethylene Glycol 400 (PEG400)

I. INTRODUCTION

Concrete, one of the most widely used construction materials globally, typically requires continuous hydration to reach its desired strength and durability. Traditional methods involve manual curing, where water is applied externally to prevent moisture loss during the early stages of setting. However, this process is labor-intensive, time-consuming, and susceptible to inconsistencies.

In response to these challenges, self-curing concrete has emerged as a revolutionary solution in the construction industry. Self-curing concrete contains internal curing agents that facilitate hydration from within, reducing the need for external water application and minimizing the risk of cracking, shrinkage, and surface defects.

The concept of self-curing agents is to reduce the water evaporation from concrete, and hence increase the water retention capacity of the concrete compared to conventional concrete. It was found that water soluble polymers can be used as self-curing agents in concrete.

II. IMPORTANCE OF SELF-CURING CONCRETE

Self-curing concrete is a type of concrete that possesses the ability to retain moisture and cure itself without requiring external curing methods such as water spraying or covering with plastic sheets. Self-curing concrete is important because it enhances durability and strength, reduces cracking, saves time and money, conserves water, ensures consistent quality, and is easy to apply.

III. COMPONENTS OF SELF-CURING CONCRETE

Cement: Ordinary Portland cement (OPC) is commonly used as the binding agent in concrete mixes. However, in self-curing concrete incorporating RHA, a portion of the OPC may be replaced with RHA to improve strength, durability, and sustainability

Rice Husk Ash (RHA):RHA is a pozzolanic material obtained from burning rice husks. It contains high silica content and can react with calcium hydroxide in the presence of moisture to form additional cementitious compounds, enhancing the strength and durability of concrete. RHA is often used as a partial replacement for cement in concrete mixes, contributing to the pozzolanic reaction and reducing the overall carbon footprint of the concrete.

Polyethylene Glycol 400 (PEG400):PEG400 is a water-soluble polymer that can act as a water-retaining agent in concrete mixes. It helps to absorb and retain moisture within the concrete matrix, facilitating self-curing without the need for external water sources. PEG400 is typically added in small quantities to the concrete mix to improve hydration and reduce shrinkage.

Aggregates: Coarse and fine aggregates, such as sand, gravel, or crushed stone, provide bulk and stability to the concrete mix. The selection of aggregates depends on factors like desired strength, workability, and availability.

Water: Water is essential for the hydration process of cement and the activation of pozzolanic reactions in RHA. In self-curing concrete mixes, water is also retained by PEG400 to facilitate self-curing without external curing methods.

These components are typically combined in varying proportions and formulations to develop self-curing concrete mixes incorporating RHA and PEG400, aiming to optimize strength, durability, and sustainability while reducing the need for external curing methods. The exact proportions and combinations may vary depending on the research objectives, materials availability, and environmental conditions.

IV. BENEFITS OF SELF-CURING CONCRETE

Enhanced Self-Curing Efficiency: RHA and PEG400 contribute to improved self-curing efficiency by promoting moisture retention within the concrete matrix. This leads to more effective hydration of cement particles and enhanced strength development.

Reduced Water Consumption: Self-curing concrete with RHA and PEG400 requires less external water for curing, leading to reduced water consumption on construction sites. This not only conserves water resources but also reduces labor and time associated with traditional curing methods.

Improved Workability: The presence of PEG400 in self-curing concrete mixes can enhance workability and pumpability, making the concrete easier to place and finish. This can lead to improved construction efficiency and quality.

Cost Savings: Although not explicitly mentioned in the provided research papers, self-curing concrete with RHA and PEG400 may offer potential cost savings due to reduced water consumption, labor requirements, and maintenance needs over the lifespan of concrete structures.

V. CHALLENGES AND FUTURE PROSPECTS

The incorporation of rice husk ash (RHA) and polyethylene glycol (PEG400) in self-curing concrete presents several challenges and future prospects. Challenges include optimizing mix proportions, assessing long-term performance, ensuring compatibility with other admixtures, establishing standardization and guidelines, evaluating economic viability, and addressing environmental impact. Future prospects include further research to optimize materials and methods, develop standardized protocols, conduct cost-benefit analyses, assess environmental sustainability, and promote technology transfer and adoption. Overall, addressing these challenges and exploring future prospects will contribute to the continued advancement and adoption of self-curing concrete technology incorporating RHA and PEG400, leading to more sustainable and durable concrete infrastructure.

VI. CONCLUSION

Water retention for the concrete mixes incorporating self-curing agent is higher compared to conventional concrete mixes, as found by the weight loss with time.

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

Water transport through self-curing concrete is lower than air-cured conventional concrete.

Slump value increases with increase in the quantity of PEG

Self-curing concrete is the answer to many problems faced due to lack of proper curing.

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[3]. "Enhancement of Self-Curing Efficiency in High-Performance Concrete with Rice Husk Ash and Polyethylene Glycol" by R. Nagarajan, M. Santhanam, and S. Shunmugasundaram. This paper discusses the use of RHA and PEG to enhance self-curing efficiency in high-performance concrete.

[4]. "Mechanical Properties and Durability of Self-Curing Concrete Incorporating Rice Husk Ash" by M. Ramezanianpour and M. Esmaeili. This paper investigates the mechanical properties and durability aspects of self-curing concrete with RHA.

[5]. "Influence of Rice Husk Ash and Polyethylene Glycol on Properties of Self-Curing Concrete" by A. B. Dhawale, S. D. Charkha, and S. G. Kolte. This study examines the influence of RHA and PEG on the properties of self-curing concrete, including strength, durability, and workability.

[6]. "Development of Self-Curing Concrete Using Rice Husk Ash and Polyethylene Glycol" by A. R. M. Youssef, M. E. El-Hawary, and H. M. Abd-El Gawwad. This paper presents the development and characterization of self-curing concrete incorporating RHA and PEG.

[7]. "Effect of Polyethylene Glycol and Rice Husk Ash on Strength and Durability Properties of Self-Curing Concrete" by M. S. Shirule and A. S. Kadam. This research paper investigates the effect of PEG and RHA on the strength and durability properties of self-curing concrete.