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Literature Review: Self Curing Concrete

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Abstract: ***Curing is one of the most important factors for achieving maximum desirable strength in concrete, concrete should be cured properly so that it is fully hydrated and loss of moisture inside the concrete should be reduced. The most regularly and abundantly used construction material is concrete because of its superior compressive strength and stability. The curing involves in retaining adequate moisture content from the time of placing the concrete until final stage, at that point of time the concrete develops the satisfied properties by promoting optimum cement hydration immediately after placement.*** *Water soluble alcohols for instance Poly Vinyl Alcohol (PVA), Poly Ethylene Glycol (PEG), and Super Absorbent Polymer (SAP) are feasible as self-curing agents in concrete.* ***The Self Curing is an "internal curing system" in which a Hydrophilic material such as Polyethylene Glycol, Paraffin wax or Acrylic acid, the polymer that is soluble in water is allowed to mix in the prepared concrete.*** *The calcium lignosulfonate (CLS) having water solubility 98% to 98.5% has been used as self-curing agent in different percentage (0.2%, 0.3%, 0.4%, and 0.5%).* ***The use of polyethylene glycol in conventional concrete as an admixture helps better hydration and hence the strength of concrete. Polyethylene glycol 400 in the order of 0, 0.5%, 1% &1.5 % by weight of cement for M 30 grade of concrete and river sand is replaced by M sand in the ratio of 30%, 40% & 50%. As well as Poly vinyl alcohol has been added to concrete by weight of cement at the dosage of 0%, 1%, 1.1%, 1.2%, 1.3% 1.4%, 1.5%, 1.6% and then the mechanical properties of concrete were tested such as compressive and split tensile strength.*** *The ratio of water to binding material (w/b) of reference concrete mixture (PC) was fixed to 0.38. S01, S02 and S03 mean the volumes of SAP are 0.1%, 0.2% and 0.3% of cementitious materials, respectively. We consider that poly ethylene glycol in concrete which helps in self-curing and helps in better hydration and hence strength.*

Index Terms: Self-Curing Concrete, Poly Ethylene Glycol, Poly Vinyl Alcohol, Super Absorbent Polymer, calcium lignosulfonate.

I. INTRODUCTION

When water is added to the concrete heat of hydration is released then concrete begins to harden, and as it hardens the water begins to evaporate mainly due to high temperature and then the water present inside concrete is not sufficient for concrete to achieve full hydration this reduces its strength, the rate of evaporation depends on the outside temperature. Curing is the process of controlling the rate and extent of moisture loss from concrete during cement hydration. It may be either after it has been placed in position (or during the manufacture of concrete products), thereby providing time for the hydration of the cement to occur. Since the hydration of cement does take time – days, and even weeks rather than hours – curing must be undertaken for a reasonable period of time. Curing of concrete without external curing method is not possible at all times(Ankith,2015). Most paving mixtures contain adequate mixing water to hydrate thecement if the moisture is not allowed to evaporate. To have a sealing surface at the top of the concrete an oil polymer or other compound need to be applied and effectively seal the surface against evaporation (Ankith, 2015; and Kavithaa et al., 2015). If the concrete is to achieve its potential strength and durability Curing may also encompass the control of temperature since this affects the rate at which cement hydrates. Curing has a strong influence on the properties of hardened concrete; proper curing will increase durability, strength, water tightness, abrasion resistance, volume stability, and resistance to freezing and thawing and de-icers. A durable concrete is one that performs satisfactorily under the anticipated exposure condition during its designed service life. In addition to the normal concrete mix some additional compounds in proper dosage and materials such as fly ash is used to increase the durability and strength of the concrete mix. Self-curing concrete reduces autogenous shrinkage and which is responsible for early age cracking (Nduka et al. 2018). Self-curing technique can be adopted in order to ensure the availability of additional internal water for hydration of cement and also mitigates the effect of water loss to surroundings. (Sri Rama Chand et al. 2015)

II. LITERATURE REVIEW

Vikant Dixit , Vivek Viswakarma , Rajeev Chandak-Use of self-curing concrete is done according to different needs and goals; it helps if water is not available near places of construction area or with expensive spending of money can provide water for curing; Self-curing concrete help for speed in construction work and having an economical project. As it is very important topic, many researchers have trying to develop it with different methods and techniques and after many studies and investigations It has been found that they used different material for having good results, some important materials which had acceptable results is super

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absorbent polymer, light weight aggregate, wood powder, polyethylene or 600 and other shrinkage reducing admixtures. Self-curing concrete is one of the special concretes in mitigating insufficient curing due to human negligence paucity of water in arid areas, inaccessibility of structures in difficult terrains and in areas where the presence of fluorides in water will badly affect the characteristics of concrete. The present study involves the use of shrinkage reducing admixture polyethylene glycol (PEG 400) in concrete which helps in self curing and helps in better hydration and hence strength. In the present study, the affect 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% were studied for M20.M30 and M40 mixes. It was found that PEG 400 could help in self curing by giving strength on par with conventional curing. It was also found that 1% of PEG 400 by weight of cement was optimum for M30 without compromising workability.

M.V.Jagannadha Kumar, M. Srikanth, K. Jagannadha Rao- Today concrete is most widely used construction material due to its good compressive strength and durability. Depending upon the nature of work the cement, fine aggregate, coarse aggregate and water are mixed in specific proportions to produce plain concrete. Plain concrete needs congenial atmosphere by providing moisture for a minimum period of 28 days for good hydration and to attain desired strength. Any laxity in curing will badly affect the strength and durability of concrete. Self-curing concrete is one of the special concretes in mitigating insufficient curing due to human negligence paucity of water in arid areas, inaccessibility of structures in difficult terrains and in areas where the presence of fluorides in water will badly affect the characteristics of concrete. The present study involves the use of shrinkage reducing admixture polyethylene glycol (PEG 400) in concrete which helps in self-curing and helps in better hydration and hence strength. In the present study, 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% were studied both for M20 and M40 mixes. It was found that PEG 400 could help in self-curing by giving strength on par with conventional curing. It was also found that 1% of PEG 400 by weight of cement was optimum for M20, while 0.5 % was optimum for M40 grade concretes for achieving maximum strength without compromising workability.

Patel Manishkumar Dahyabhai, Prof. Jayeshkumar R. Pitroda- The imagination of a world without concrete is impossible. Concrete is a soul of infrastructures. Concrete is necessary to gain strength in structures. Conventional concrete, which is the mixture of cement, fine aggregate, coarse aggregate and water, needs curing to achieve strength. So it is required to cure for a minimum period of 28 days for good hydration and to achieve target strength. Lack of proper curing can badly affect the strength and durability. Self-curing concrete is one type of modern concrete, which cure itself by retaining water (moisture content) in it. The use of POLYETHYLENE GLYCOL in conventional concrete as an admixture helps better hydration and hence the strength of concrete. In this research paper, the individual effect of admixture PEG600 & PEG1500 on compressive strength by varying the percentage of PEG600 and PEG1500 by weight of cement 0.5%, 1.0%, 1.5% and 2% were studied. The study shows that PEG600 and PEG1500 could help in gaining the strength of conventional curing. It was also found that 1% of both PEG600 and PEG1500 by weight of cement was optimum for M25 grade concrete for achieving maximum strength without compromising workability. The test result indicates that use of water soluble polymers in concrete has improved performance of concrete.

N. Y. ELWakkad, KH. M. Heiza, Prof Dr Aqial- Mechanical properties of concrete depend on the curing condition of concrete. The ACI-308(2010) through ACI-308(2014) Code states that “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”, curing concrete means that water is not lost from the surface i.e., curing is taken to happen from the outside to inside. In contrast, internal curing is allowing for curing ‘from the inside to outside. Internal curing’ is often also referred as ‘Self–curing.’ Any negligence in curing will interfere in the strength and durability of concrete. Shrinkage reducing agents and lightweight aggregates such as Leca and Polyethylene-glycol, Silica fume and stone chips are used respectively to achieve effective curing results. It is observed that there is an increase in compressive strength by using polyethylene glycol (PEG) and light weight fine aggregate (LWA).

Muddassir Bora, Mausam Vohra, Mohammed Sakil Patel, Dhruv Vyas- The strength and durability of concrete depends on the curing of concrete. The ACI-308 Code states that “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.” Conventionally, curing concrete means creating conditions such that water is not lost from the surface i.e., curing is taken to happen ‘from the outside to inside’. In contrast, ‘internal curing’ is allowing for curing ‘from the inside to outside’ through the internal reservoirs (in the form of saturated lightweight fine aggregates, superabsorbent polymers, or saturated wood fibers) Created. ‘Internal curing’ is often also referred as ‘Self– curing.’ Any negligence in in curing will interfere in the strength and durability of concrete. Shrinkage reducing agents and lightweight aggregates such as Polyethylene-glycol and Leca, Silica fume and stone chips are used respectively to achieve effective curing results.

N. Dharani- Concrete is the most generally utilized material because of its quality, lastingness and sturdiness. The water is being utilized as a part of making solid, its utilization is high in the curing practice. Inadequate curing can severely affect the durability and strength of the concrete. Self-curing or internal curing is a method that provides extra moisture inside the concrete for effective hydration of cement and decreases self-desiccation. The hydration of cement takes place due to the availability of additional internal water through internal reservoirs like light weight aggregate, super absorbent polymers and shrinkage reducing admixture. The investigation is aimed towards the production of concrete that are equal or superior to traditional form of curing through the addition of self-curing admixture without compromising the strength In this present study, concrete cubes, cylinder and prism were casted to examine the effect of PEG on compressive strength of cube, split tensile strength of cylinder and flexural strength of prism with different proportions of Polyethylene glycol 400 in the order of 0,0.5 %,1% &1.5 % by weight of cement for M 30 grade of concrete and river sand is replaced by M sand in the ratio of 30% ,40% &50 % . From the test results, it was found that 40% M sand and 1% PEG 400 as optimum percentage.

Shahzeb Khuwaja, Aneel Kumar, Samar Hussain Rizvi, Shabir Magsi, Farhan Shaikh- Curing is one of the most important factors for achieving maximum desirable strength in concrete, concrete should be cured properly so that it is fully hydrated and loss of moisture inside the concrete should be reduced. Poly vinyl alcohol is locally available chemical which can be used as a self-curing agent in concrete so that moisture in the concrete can be maintained and concrete can be fully hydrated. In this paper Poly vinyl alcohol has been added to concrete by weight of cement at the dosage of 0%, 1%, 1.1%, 1.2%, 1.3% 1.4%, 1.5%, 1.6% and then the mechanical properties of concrete were tested such as compressive and split tensile strength. It is observed that workability is increasing with increasing the dose of poly vinyl alcohol and there is no significant increase in compressive and split tensile strength relative to conventional concrete.

Rahul Dev rishu- The aim of this thesis is to revise concerning the power and stability of concrete with water-soluble polyethylene glycol as self-curing agent. This agent will lessen the water disappearance from concrete. The goal of this investigation is to look at the strength and durability houses of concrete the usage of water-soluble Polyethylene Glycol as self-curing agent. The characteristic of self-curing agent is to reduce the water evaporation from concrete, and therefore they growth the water retention capacity of concrete as compared to the conventionally cured concrete. The use of self-curing admixtures may be very crucial from the point of view that saving of water is a necessity every day (every one cubic meter of concrete calls for 3m3 of water in a construction, most of that's used for curing).In this examine, compressive energy and break up the tensile power of concrete containing self-curing agent is investigated and in comparison with those of conventionally cured concrete. It is observed via this experimental take a look at that concrete cast with Polyethylene Glycol as self-curing agent is stronger than that received via sprinkler curing in addition to by using immersion curing.

Bhanu Pratap Gupta, Meghna- By curing, the concrete maintains a sufficient amount of moisture content so that the concrete can achieve its desired properties. With the help of self-curing, the moisture present in the concrete is held so that it does not evaporate. If curing is done after the concrete is prepared, using external curing then potable water is used more in this process. Self-curing of concrete is done to save this potable water. The function of self-curing is to make the water less vanishing from the concrete and hold the moisture content in it, mostly in the beginning. There are many self-cured agents like Polyvinyl Alcohol (PVA), Sodium Lignosulfonate (SL) and Polyethylene Glycol (PEG) etc. using which concrete is made self-cured. By using self-curing concrete in construction, we can also save a lot of money. Now a days, potable water is hardly available for drinking, so how we use it for curing. In the future, self-curing concrete will be used more because external water is not needed for curing.

E.Arundhava Priya, A.Gopalan, N.Mohanra -Concrete is the ancient material of construction. The relative volumes of concrete floor, coarse get worse, fine blend and standard water mixed along control the properties of concrete. Unnecessary evaporation of water out of fresh concrete should be eliminated, otherwise the level of cement hydrating would obtain lowered and thereby tangible may develop unsatisfactory properties. To enhance real property, curing of concrete is identified as providing satisfactory moisture, temp and time for to allow the real to achieve the sought after properties. It is also described as keeping the concrete in moist and enough so that the hydration of cement can certainly continue this project aims to study the potency of concrete attained by self-curing method. Self-curing or water less curing is a type which can be used to hold the moisture in concrete for ideal hydration of cement and minimize the self-desiccation. Conventionally, curing of concrete means making conditions such that water is not lost from the specimen through the surface. Polyethylene Glycol, Paraffin Wax, Acrylic corrosive are a portion of the regularly accessible hydrophilic materials which is used in self curing. The experimental study is done by using sodium lignosulfonate as a self –curing agent and partially replacing coarse aggregate with light weight aggregate (waste granite).The devastating quality and split elasticity of self-restoring concrete with fluctuating rates (0.5%, 1%, 1.5%, 2%) of sodium lignosulfonate and 10% substitution of not substantial aggregate for 7, 14, 28 days is tried and contrasted and customary cement of comparative blend structure.

III. MATERIAL USED

A. Cement

Cement utilized as a part of the examination was 53 grade ordinary Portland cement affirming IS: 12269: 2013.The physical properties of cement were tested as per IS 4031-1988.

Properties and Result

Fineness of cement -1%

Consistency of cement- 33%

Initial setting time-90 min

Final setting time -320 min

B. Fine Aggregate

1) River Sand

Sand or stone dust and its size is limited to 4.75mm gauge, passing through 4.75mm IS sieve but retained on 75micron sieve according to the IS: 383–2016 code recommendations are used for the experiment.

2) Properties of River Sand

Specific gravity 2.67

Bulk density 1765.02 kg/m3

Particle size distribution zone II

3) M sand

Manufactured sand is a purpose-made crushed fine aggregate and is produced from a suitable source material. The quality of the river sand depends normally on its source but mostly it varies a lot. Therefore, it is essential to replace natural sand in concrete by an alternate material either partially or completely without compromising the quality of concrete.

4) Properties of M Sand

Specific gravity 2.61

Bulk density 1789.12 kg/m3

Particle size distribution zone II

C. Coarse Aggregate

Crushed stones of size 20mm is used as a coarse aggregate. The coarse aggregate satisfying the properties according to IS: 383-2016 was used. The physical properties of coarse aggregate were tested as per IS: 383: 2016.

1) Properties of Coarse Aggregate

Specific gravity 2.83

Bulk density 1812.5 kg/m3

2) Water

Potable water is used for the experimental work for preparing the concrete and it should be free from sugar, salt, organic matter etc. confirming to IS 456:2000.

3) Polyethylene Glycol

Polyethylene glycol is non-lethal, unscented, unbiased, greasing up, non-unstable and non- disturbing, is utilized as a part of an assortment of pharmaceuticals.

4) Physical Properties of PEG 400

Appearance - Clear liquid or white solid.

Odour- Mild odour.

Solubility -Soluble in water.

Density -1.1 to 1.2 (increases as molecular weight increases)

Boiling Point -Min. 250°C (1013 hPa) Vapor Pressure (mm Hg) -Vapor pressure is very low; as molecular weight increases, vapor pressure decreases.

IV. CONCLUSION

Based on literature review, following conclusions are obtained:

The optimum dosage of PEG400 for maximum strength (compressive, tensile and modulus of rupture) was found to be 1% for the M20.

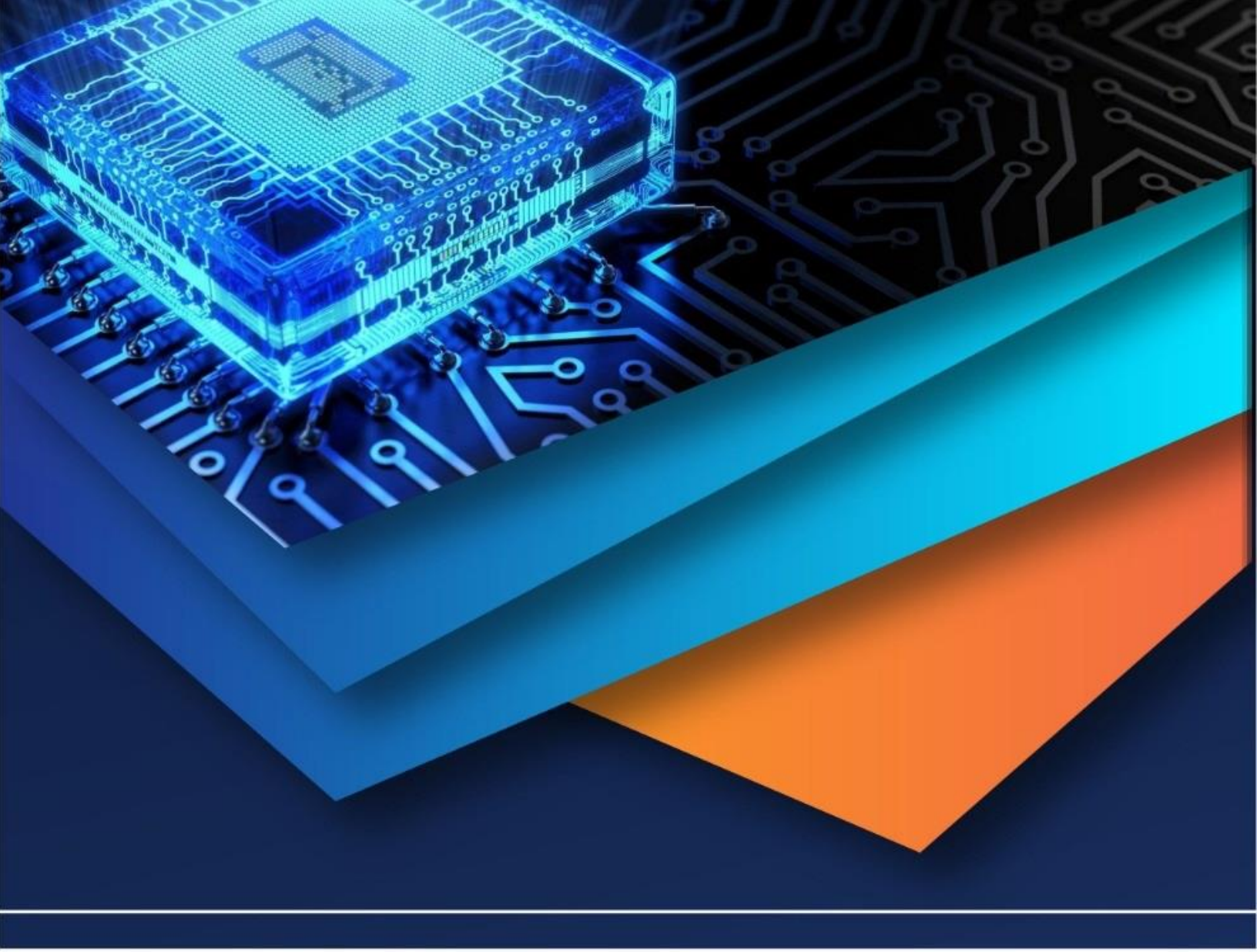
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As percentage of PEG400 increased slump increased for M20 grade of concrete.
Strength of self-curing concrete is on par with conventional concrete.
Self-curing concrete is the answer to many problems faced due to lack of proper curing.
Self-curing concrete is an alternative to conventional concrete in desert regions where scarcity of water is a major problem.

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