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# A Literature Review on Experimental Studies on Properties of Self-Curing Concrete using Poly-Ethylene Glycol-400

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***Abstract:*** ***Curing is the most important part of concrete in construction. Nowadays there are much shortage of water in some areas, therefore curing cannot be done properly and also curing cannot be done properly in many cases due to inattention of human, inaccessibility of structure and areas, and some time due to presence of fluoride. There are two types of curing, first one is External Curing which is done by manually by human, and the second one is External Curing (Self-Curing) which is done by curing agent. Self-curing of concrete maintain the require moisture content and helps the concrete to obtain its strength and durability. Self-Curing method decrease the water evaporation, therefore water remains in the concrete as compared to conventional concrete. Specially for curing process nowadays water requires are 3m$^3$ in 1m$^3$of concrete. Self-Curing admixture is much important and beneficial where water resource is insufficient. The admixture is a water soluble polymer. Fly ash improves concrete's workability, ultimate strength and durability as well as solves many problems. In this study polymer added with 0.5% and 1% by weight of cement and fly ash added with 20% by weight of cement.***
***Keywords: Poly Ethylene Glycol-400, Fly ash, Compressive strength, Split tensile strength***

## I. INTRODUCTION

Concrete is the mixture of cement, fine aggregate and coarse aggregate. From the last 20 years concrete technology is going rapid development. Curing is the most important phenomena in concrete and its reliable strength. The use of curing is to upgrading the hydration of cement and controls the temperature and moisture. Curing allows continuous hydration of cement and promotes continuous gain in strength. Once curing stop, strength gain also stop. Requirement of good performance and durability in concrete structure need proper curing.

Self-curing method is use to procure extra moisture in concrete for effective hydration of cement and reduce evaporation. Curing of water is much requisite, when the complete reaction of mineral admixture in a mixture cement system. According to ACI 308 committee "internal curing refers to the process by which hydration of cement happen because of the availability of extra internal water that is not a part of the mixing water", internal curing benefits are observed at ages as soon as 2-3 days because impact of internal curing begins immediately with the initial hydration of cement.

Polyethylene glycol (PEG) is also known as Polyethylene oxide (PEO). PEG is the most commercially important polyether used as self-curing agent. PEG 400 (polyethylene glycol 400) is a low-molecular-weight grade of polyethylene glycol, it is a clear, colorless, viscous liquid. PEG 400 is widely used in a variety of pharmaceutical formulations. PEG-400 is soluble in water, acetone, alcohols, benzene, glycerin, glycols, and aromatic hydrocarbons. It is slightly soluble in aliphatic hydrocarbons. PEG and PEO are prepared by polymerization of Ethylene Oxide and are commercially available. Polyethylene glycol is a condensation polymer of ethylene oxide and water with the general formula H(OCH 2CH 2)nOH, where n is the average number of repeating ox ethylene group. Their melting points vary depending on the formula weight of the polymer.

## II. LITERATURE REVIEW

*A.* Dhiret. al. (1996) (1) Reported that amid the advancement of self-curing solid. It was observed that one specific self-curing admixture deliver various impacts concerning specific physical properties. Two PC models, at low measurements, great quality and enhanced penetrability attributes were watched. At high measurement it gives the idea that the admixture harmfully affects the solid's compressive quality because of a change of the regular of calcium hydroxide and the C-S-H gel structure was adjust advantageously delivering an exceedingly impermeable solid. It is proposed that in hatred of the fact that a bringing down of quality at high dose, a much lower penetrability of given quality could be acquired.

*B.* Hans W. Reinhardt et al. (1998) (2) they pointed on self-cured elect solid that a partial substitution of customary weight totals by pre-wetted lightweight totals inspire an interior water supply for consistent hydration of cement. In spite of water misfortune by vanishing there is nonstop quality increase up to 20-25% more quality following 1 year contrasted with standard compressive testing following 28 days. Typical weight total cement achieved extensively less quality at the same stockpiling condition, use of such cement by and by implies that no curing, because of terrible workmanship would not impede the solid. Descent and flow research manages transport properties dispersion, penetrability and long haul quality. Barrita et al. (2004) assessed elite solid blends that can be utilized effectively as a part of hot dry atmospheres. In this exploration attractive reverberation imaging (MRI) was utilized to quantify the avalibility of expanding the clammy curing period by fusing some immersed light weight totals into a solid blend being put in hot dry climatic conditions. A progression of solid blends were readied and sodden cured for 0-0.5 for 1-3 days, or by utilizing a curing compound, trailed via air drying at 39°C and 40% relative stickiness. To finish this, 11% by volume of the aggregate total substance was supplanted with lightweight total, sort Portland bond and quartz total in addition to the lightweight total were all chosen for their low iron substance to minimize antagonistically influencing the MRI estimations. The solid blends were low quality solid, self-combining solid (containing 20% fly fiery debris), and high quality solid (containing 9% silica seethe).

*C.* Roland Tak Yong Liang et al. (2002) (3) carried work on internal curing composition for concrete which includes a poly ethylene glycol. The invention provides for the first time an internal curing composition which, when added to concrete or other cementitious mixes meets the required standards of curing as per Australian Standard AS 3799.

*D.* Vedhasakthi K et al. (2014) (4) studied the investigation, workability and strength characteristics of Normal Strength and High Strength Concrete. Cast with the self curing agents have been studied and compared with the corresponding conventionally cured concrete. For the Normal Strength of Self-Curing Concrete of grade M20-M40 IS method of mix design were adopted, Super plasticizer dosage was varied.

*E.* Patel Manish Kumar Dahyabhai et al. (2014) (5) presented the results of an experimental investigation carried out to find out the effect of admixture (PEG-400) on compressive strength and split tensile strength by varying the percentage of PEG by weight of cement from 0%-2% . M20 grade concrete is considered for the study. The study shows that PEG400 could help with self-curing by giving strength on par with conventional curing. It was found that 1% of PEG-400 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.

*F.* Shikha Tyagi (2015) (6) Studied on self-curing concrete and had use PEG-400 as a self-curing agent in concrete. M25 and M40 grade of concrete are adopted for investigation, she added 1-2% of PEG400 by weight of cement for M25 and M40 grade concrete; she was concluded that the best dosage of PEG-400 for maximum Compressive strength was 1.5% for M25 and 1% for M4O grades of concrete.

*G.* Sreenivasa kumar A et al. (2015) (7) Studied the effect of admixture (PEG-200) on compressive strength, split tensile strength at one percentage for M25 mix was studied and it compared with the properties of PEA ( Poly Ethylene Alcohol), also studied the mechanical characteristics of concrete such as compressive strength and split tensile strength by varying the percentage of PEG and PEA from 0%-2% by weight of cement of M25 grade concrete. He concluded that the optimum strength values for both the self-curing agents were found and among both the agents PEG-200 is a best and good self curing agent because in the durability and normal compressive strength behalf. It has given good results when compared with both conventional concrete and Poly Ethylene Alcohol (PAE). It was found that Poly Ethylene Glycol-200 is a good self-curing agent when compared with Poly Ethylene Alcohol.

*H.* Wen-Chen Jau (2015) (8) said that self-curing agent is provided to absorb water from enviroment and air to get better hydration of cement in concrete. It reduces the problem when the degree of cement hydration is decreses due to no curing or unfair curing by using poly-acrylic acid as a self-curing agent, which has strong capability of absorbing moisture from environment and provide required water for self-curing concret

*I.* Shikha Tyagi (2015) (9) in her study, the effect of curing compound on workability (slump and compaction factor) and compressive strength is studied, in this study the percentage of PEG by weight of cement from 0%-2% as the dosage of internal curing compound was fixed .The test results were studied both for M25 and M40 mixes. It is found through this experiment study that PEG-400 help in self curing by giving strength on par with that of the conventional curing method and also improved workability. The optimum dosage of PEG-400 for maximum strength was found to be 1,5% for M25 and 1% for M40 grade, as percentage of PEG-400 increased slump for M25 and M40 grades of concrete.

*J.* Sona K. S et al. (2015) (10) studied Internal curing technique that can be used to provide additional moisture in concrete for effective hydration of cement. The impact of transform in strength parameters i.e., compressive strength and split tensile strength were studied for different dosage of self-curing agent and compared with that of lineal cured concrete. The optimum dosage of SAP for maximum compressive strength split tensile strength was found to be 0.5% of weight of cement for M25 and M30, also determine Self curing concrete was the best solution to the problems faced in the desert region and also faced causes to lack of proper curing.

*K.* Magda I. Mousa et al. (2015) (11), investigated about physical properties of self-curing concrete, first used type is pre-soaked lightweight aggregate with different percentage of 0.0%, 10%, 15% and 20% of volume of sand. Second used type is a chemical agent of polyethylene glycol with different percentage of 1%, 2% and 3% weight of cement. Three cement content 300, 400, and 500 kg/m3. Three-different water cement ratios 0.5, 0.4 and 0.3 and two magnitudes of silica fume as pozzolanic additive 0% and 15% of cement weight, at different ages up to 28days. Result show that use of PEG develop the physical properties of concrete. The 15% of light weight aggregate was effective while 20% saturated light weight aggregate was effective for permeability and mass loss but adversely volumetric water absorption. PEG was more effective than light weight aggregate, in all cases 2% PEG and 15% light weight aggregate were optimum values. Higher cement content or lower water cement ratio had more effective results and adding silica fume into concrete increase all physical properties.

*L.* Mohammed Shafeeque Sanofar.P.B et al. (2016) (12) has used PEG-600 as a self-curing agent in concrete, M20 and M25grade of concrete are adopted for investigation. They added 0-2% of PEG-600 by weight of cement for M20 and M25 grade concrete. From that they underlay 1% of PEG-600 by weight of cement was optimal for M20 and M25 grade of concrete for achieve outmost strength.

*M.* Basil M Joseph (2016) (13) Studied on self-curing concrete and PEG-400 were used as a self-curing agent in concrete. M20 grade of concrete is adopted for investigation, he added 0-1.5% of PEG-400 by weight of cement for M20 grade concrete from that he found 1% of PEG-400 by weight of cement was optimum for M20 grade of concrete for achieve maximum strength, he also found that if percentage of PEG-400 gets increased slump as well as compaction factor also increased.

*N.* Vishnu Kumari M (2016) (14) aim to compare strength of M30 grade concrete achieved by conventional curing method and self-curing method. The present study involves the use of shrinkage decreasing admixture polyethylene glycol in concrete which helps in self-curing and also helps in better hydration and therefore strength. Both PEG-400 and PEG-200 are used in the study in 0%-2% by weight of cement. The compressive strength of concrete mix rised by 12.05% by adding 1.0% of PEG-400 and 9.19% by adding 0.5% of PEG-200 as compared to the conventional concrete. The optimal dosage of PEG-400 for outmost compressive strengths was found to be 1% of weight of cement for M30 grades of concrete, the optimal dosage of PEG-200 for outmost compressive strengths was found to be 0.5% of weight of cement for M30 grades of concrete

*O.* M.Priya et al. (2016) (15), in this analysis on self-curing concrete by adding of super absorbent polymer, PEG admixtures with 2%-6%of wood powder, obtained result for 2% and 4% of wood powder compare to conventional concrete was found low compressive strength but 6% of wood powder compare to conventional concrete is high compressive strength.

*P.* Dayalan J (2016) (16) had used super absorbent polymers as a self-curing agent in concrete. He was added 0-0.48% of super absorbent polymer by weight of cement for M25 grade concrete, he was found that super absorbent polymer 0.48% by the weight of cement provides higher compressive, tensile as well as flexural strength than the strength of conventional mix.

*Q.* Stella Evangeline (2017) (17) had use poly vinyl alcohol as self-curing agent in concrete. He added 0-0.48% by weight of cement from that he found 0.48% of poly vinyl alcohol by weight of cement supply higher compressive strength, tensile strength as well as flexural strength than the strengths of conventional mix.

*R.* Patel Manishkumar et al. (2017) (18) Pitroda studied on “introducing the self-curing concrete in construction industry”, compressive strength of self-curing concrete is increased by applying self-curing admixtures. The compressive strength of concrete mix rised by 38% by adding 1% of PEG-600 and 34 by adding 1% of PEG-1500 as compared to the conventional concrete, the optimal dosage of PEG-600 for best compressive strength was found to be 1% of weight of cement for M25 grade of concrete. The optimal dosage of PEG-1500 of outmost compressive strength was found to be 1% of weight of cement for M25 grade of concrete. Self-curing concrete is the best resolution to the problem faced in the sand region and faced due to lack of proper curing.

*S.* Azhagarsamy S et al.(2018) (19) studied about compressive and split tensile strength of M25 grade concrete mix for 0.5%, 1%, 1.5% and 2% PEG-400 at the age of 3,7 and 28 days. The result for 0.5% PEG-400 the compressive strength showed an increasing of 18.76, 32.6 and 44.5 N/mm2, by using of 1% and 1.5% of PEG-400 the maximum value obtained at the end of 28 days for 1% and 1.5% was 47.8 and 43.1 N/mm2, 2% of PEG-400 showed a decreasing trend in the compressive strength at the

end of 3,7 and 28 days the compressive strength observed at the end of 28days for 2% of PEG-400 is 38.3N/mm2. Split tensile strength at the end of 3, 7 and 28 days for 0.5% PEG-400 showed the increasing value of 1.76, 2.84 and 5.09 N/mm2. Result for tensile strength for adding 1% and 1.5% PEG-400 in 28days was 5.16 and 4.72 N/mm2, with 2% showed decreasing trend in the split ensile strength at the end of 3,7 and 28 days. For 2% in 28days was 4.35 N/mm$^2$.

## III. CONCLUSION

The review of earlier studies related to partial replacement of Cement with fly ash and adding poly-ethylene glycol-400 at different percentage reveals that there is a significant change in the strength properties of concrete such as compressive strength, flexural strength, split tensile strength. These experiments were carried out in various grade concrete to find out the result, from the above literature reviews optimum percentage of fly ash varies from 5% to 30% and Poly-ethylene Glycol-400 varies from 0.5% to 2%. Up to this Percentage Replacement improvement in the strength of concrete has been observed in terms of Compressive Strength, Flexural Strength and Tensile Strength. Previous studied also shows that fly ash and Poly-ethylene Glycol-400 concretes possess superior durability properties.

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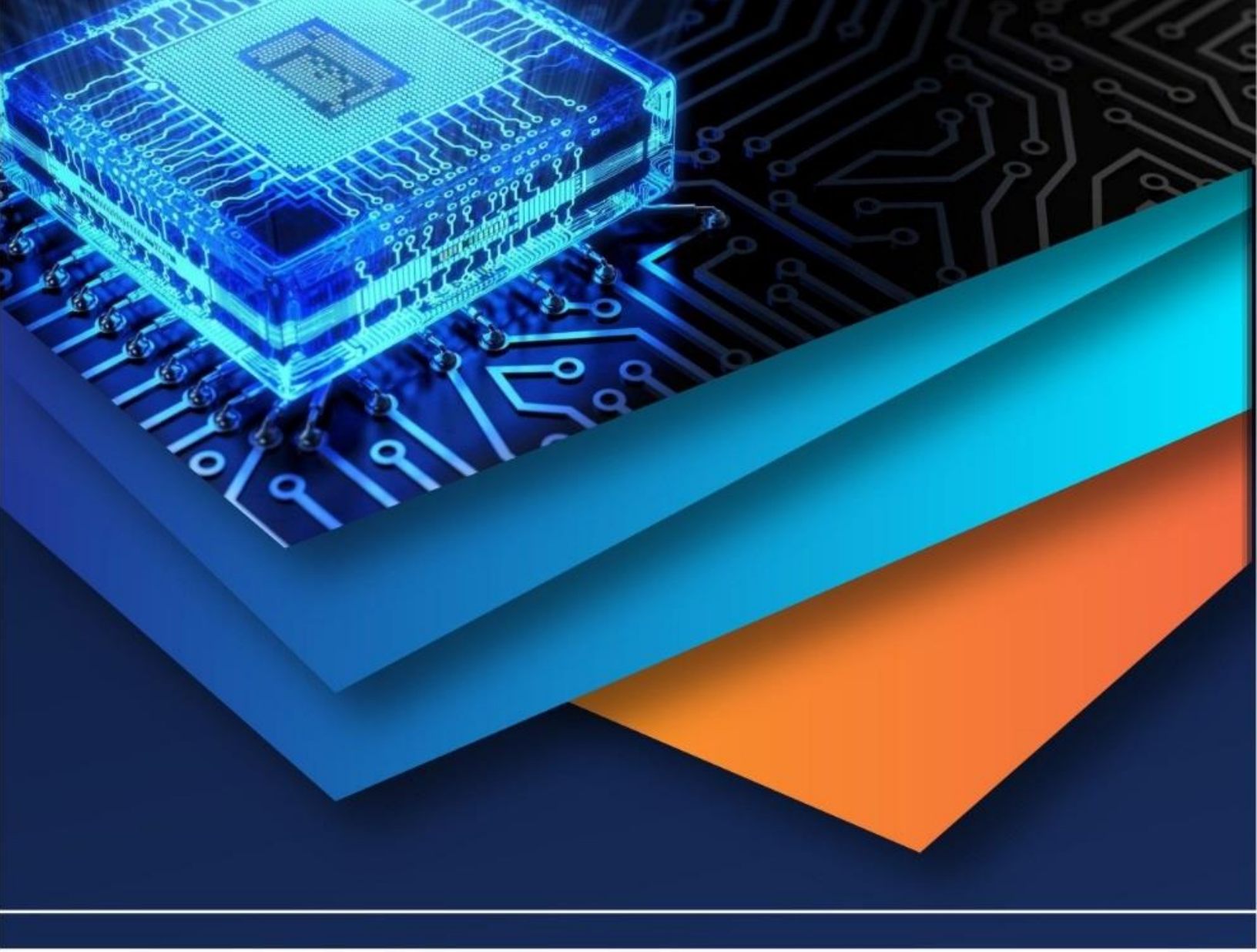

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