Effect of Self Curing on Mechanical Properties of Rigid Pavements - A Review

D. Nagoor Vali[1] Mr. B. P. R. V. S Priyatham[2] Mr. D. V. S. K. Chaitanya[3] Mr. Bimalendu Dash[4]
[1]P.G Student [2,3,4]Assistant Professor
[1,2,3,4]Department of Civil Engineering
[1,2,4]GMR Institute of Technology, Rajam, India [3]Acharya Nagarjuna University, Guntur, India

Abstract— In construction industries concrete is primary requirement to build. Curing plays a most vital role after construction but requires huge amount of water which is lacking now a days. People are even struggling for water at present to meet daily requirements. In this scenario self-curing concrete can be used which reduces water usage in whole construction work as each cubic meter of concrete requires 3m3 of water for curing purpose Now a days for curing concrete without usage of water, water proofing compounds, shrinkage reducing admixtures, water soluble alcohols are utilized without compromising the strength and durability properties. In this context the effect of addition of different types of self-curing compounds and their effect on the Mechanical properties done by the researchers are reviewed based on the past literature.

Keywords: Concrete, Self curing concrete, Self curing compounds

I. INTRODUCTION

Now a day's construction is growing rapidly as the population is increasing in the present times and concrete is one of the most essential material for construction as the structural performance of any building and the durability depends on various parameters which are included in concreting. One of the most important parameter is curing and is defined as "the process by which hydraulic cement concrete matures and develops hardened properties over time as a result of the continued hydration of cement in the presence of sufficient water and heat" as per ACI – 308. Curing is the process of preventing the loss of moisture from the concrete as per IS 456:2000.

Proper curing is required to obtain the desired strength and performance of concrete. In conventional concrete curing is done after the ingredients are mixed in suitable proportions, placing, casting and finishing are done. Different varieties of curing includes water curing (immersion, ponding, spraying, wet curing), steam curing, and self/membrane curing and miscellaneous curing (by infrared and electrical curing). Curing does not mean the application of water, it means the creation of condition for promotion of uninterrupted and progressive hydration. Concrete in which the mixing water is restricted by means of some chemical compounds, to go out from the concrete body is known as self curing concrete.

A. Mechanism of Self Curing

Self curing is a technique which is used to provide proper moisture contents in concrete for better hydration for a long time."Self curing refers to the process by which the hydration of cement occurs because of the availability of additional internal water that is not a part of the mixing water." Conventionally, curing concrete means providing the conditions such that water is not lost from the surface during hydration i.e., curing is happening from the outside to the inside. On the other side, internal curing is occurring from the inside to outside through the internal reservoirs. Self Curing is often also referred as internal curing.

B. Need of Self Curing

Sometimes works are carried out in place where there is shortage of water and the application of water curing is not possible for reasons of economy. Prevention of water loss from the surface of flat concrete works such as highways and airports are the challenging task for construction managers. If the evaporation of water from concrete are not prevented properly it results in plastic shrinkage cracks, poorly formed hydrated products, finishing problems and other surface defects.

Self curing is primarily done by the use of Light weight aggregate, Super Absorbent Polymers and Shrinkage reducing admixture. Saturated porous lightweight aggregate (LWA) are used in order to supply an internal source of water. Propylene glycol i.e. poly-ethylene glycol (PEG) or polyvinyl alcohol are the SRA materials which reduces the evaporation of water from the surface of concrete and also helps in water retention. The curing compounds are of two types. Internal curing compounds and External curing compounds. Self-curing is also referred as Internal Self Curing can be done by using hydrophilic compounds (Shrinkage Reducing Admixtures), Super Absorbing Polymers (SAP), Light Weight Aggregates (LWA), PEG. Internal curing compounds are soluble in water. The compounds used in liquid, powder form. Ex-Liquid paraffin wax, PEG-400, Sika Antisol, Resikon Resikure, Master kure cc180wb, shali cure ss, K2 kure. External Self Curing can be done by applying coating that forms impermeable membrane over the specimen after casting. Ex- Paraffin wax, Perma cure wb white, Mridul Crystals soy wax white, 107 crystalline, bandit cure.

II. LITERATURE REVIEW

Clista Babu et al., (2017) [1] investigated the effect of mechanical properties of concrete which are subjected to self curing by varying the proportions of Liquid paraffin wax and super absorbent polymers. Self curing concrete by adding 0.2%, 0.4% and 0.6% by weight of cement of SAP and 0.1%, 0.5% and 1.0% by weight cement of LPW was prepared are tested for compressive, split tensile and flexural strengths. The compressive strength increases with LPW up to 0.5% and then it is decreased for 1.0% of LPW with every combination of SAP. Concrete with 0.6 % SAP and 0.5% LPW yields better tensile strength as compared to other mixes and the flexural strength is comparatively lower for all the mixes when compared with conventional concrete.

Alaa A. Bashandy et al., (2017) [2] investigate the effect of PEG (Poly ethylene Glycol) and PAM (Poly Acrylamide) as curing agents for self curing concrete. Test

results showed that the self-curing concrete cured by each agent performed better in hardened properties compared to none cured concrete. Also, curing using the both agents (PEG + PAM) together perform better than using each one individually. Also the cost of PAM is less when compared to PEG so that it can be used in poor water areas.

M.Pavan Kumar et al., (2016) [3] The use of liquid paraffin wax is to minimize the evaporation of water from concrete specimen and thus maximize the water holding capacity of hydration process. The test conducted on the specimens subjected to water and air curing and are tested for compressive strength, spilt tensile test, flexural strength by the addition of conplast SP 430 as an admixture. Author concluded that the addition of LPW @0.1% by weight of cement to the concrete mix shows a significant variation of strength.

T Suresh Babu et al., (2015) [4] had studied the effect of properties of concrete when it is cured by the addition of self curing compound Poly Ethylene Glycol 400. It is added to the concrete mix by the dosage of PEG 400 at 0%, 0.5%, 1% and 1.5% by weight of cement and the optimum dosage of the curing compound is found to be 1% for the compressive strength for M25 grade concrete

Kamatham Radhakrishna et al., (2015) [5] suggested the usage of water soluble alcohols like poly vinyl alcohol (synthetic polymer), poly ethylene glycol, polyacryl amide as a self curing agent in self curing concrete. PVA acts as an adhesive and emulsifying agent containing two OH groups which helps to retain the water in concrete. PVA is added to the concrete at a dosage of 0.03%, 0.06%, 0.12%, 0.24%, and 0.48% by the weight of cement to the concrete mix and the optimum dosage is 0.12%.

Mousa et al (2015)., [6] studied the effect of self curing concrete types on water retention and durability, with or without silica fume along with shrinkage reducing admixture poly ethylene glycol and leca as self curing agent. Author suggested that the addition of 15% silica fume along with self curing agents shows remarkable improvement in the concrete properties, however the addition of 2% of PEG along with silica fume shows an enhancement in the results and durability properties in all curing conditions.

Pamnani Nanak j et al (2014) [7] studied the effect of self curing self compacted concrete using poly ethylene glycol (PEG 600, PEG 1500) and compared with self compacting concrete of same grades with conventional curing, self curing and dry curing techniques. Self compacting concrete incorporated with poly ethylene glycol has good water retention and hydration quality. Curing with PEG 1500 gives same strength as that of the curing done by the convention methods. Even self compacting concrete can be cured by curing agents where there is a scarcity of water.

Ya Wei et al (2014) [8] explored on internal curing efficiency of prewetted LWFAS on Concrete Humidity and Autogenous Shrinkage development. For better understanding of internal curing technology for durable concretes, the author had investigated the microstructure and the Desorption properties of fly ash and expanded shale LWFAs. The impact of these two kinds of LWFAs on autogenous shrinkage and internal RH advancement were experimentally found out in concrete with w/c of 0.3 and 0.4.

C.Chella Gifta et al (2013) [9] has studied the effect of internal curing of high performance concrete using super absorbent polymers and light weight aggregates which possess the capacity of absorbing large quantity of water during preparation of concrete and form large inclusions which contain free water which helps in the hydration of cement. Author concluded that the compressive strength is high for conventional concrete at 3 days but after 28 days concrete having LWA has higher compressive strength than other mixes. Split Tensile and flexural strength are also more for the concrete mixes which contain LWA as an internal curing material and concrete with SAP is also nearer to that of LWA. Durability studies showed that internal curing by means of SAP has less chloride penetration than the specimens with LWA.

A.Aielstein Rozario et al (2013) [10]: Studied the effect of sulphate resistance of self cured fly ash based concrete. In this research work sulphate attack measurement on self curing concrete was measured at 28 days and 56 days for M-20, M-30, M-40, M-50 grade of concrete. Percentage of weight loss of self cured concrete at 28 days and 56 days was measured. During entire research workability of concrete mixes was comparable with slump ranging from 100 mm. The concrete mix design was carried out for different grades and the percentage of fly ash replacements are 10%, 15%, 20%, 25% used. Results indicate that permeability of concrete decreases with increase in replacement of fly ash with cement and in addition of PEG dosage. So penetration of chemicals (Na2So4) is decreased with addition of PEG and concrete is safe against sulphate. The percentage of weight loss of the concrete specimens is also decreased for every grade of concrete.

M.V.Jagannadha Kumar et all (2012) [11] has inferred that the mixing of Poly ethylene glycol in estimated quantity will increases the strength parameters. In their study, the dosage of polyethylene glycol to be added was found to be 1% and 0.5% for M20 and M40 grades respectively for better strengths. As the dose of polyethylene glycol increases automatically slump values also increases.

M.Geetha et al., (2011) [12]: In this research paper the author had compared the strength and durability properties of different grade concrete by using polymeric materials without use any external water. Grade of concrete selected was M20, M30 and M40. Spinacia oleracea (palak greens) of 0.6% to 0.8% weight of cement is added as admixture to concrete. Erukkampal at 0.2% to 0.4% and polyethylelne at 0.2% to 0.4% of cement were used as self curing agent. During experimental work splite tensile strength, cylindrical compressive strength, acid resistance, sea water resistance and accelerated corrosion of concrete was observed. The strength as well as durability properties of specimens with palak green was better than other three alternatives and proved be best when compared to external curing. Also the cost of internal curing was cheaper than external curing

C. Selvamony et al., (2010) [13]: In this research work was carried out on self compacted self curing concrete. Effect of replacement of cement, fine aggregates, and coarse aggregates was replaced with limestone powder by silica fume, quarry dust and clinkers respectively. Also combination of properties on properties of SCC has been

compared. The use of silica fume in Concrete significantly increased the dosage of super plasticiser (SP). At the same constant super plasticizer dosage (0·8%) and mineral additives content (30%), lime stone powder can better improve the workability than that of control and fine aggregate mixtures by (5 % to 45 %). However, the results of this study suggest that certain quarry dust, silica fume and lime stone powder combinations can improve the workability of SCCs, more than quarry dust, silica fume and lime stone powder alone. Silica fume can better reducing effect on total water absorption while quarry dust and lime stone powder will not have the same effect, at 28 days.

III. CONCLUSION

The following concluded were drawn from a broad overview of the literature review.

1) Strength of self curing concrete is on par with conventional concrete so that it can be used in areas where there is water scarcity.
2) Self curing is adopted as an alternative approach where there is a lack of proper curing.
3) Performance of self curing compound is dependent on the water cement ration and grade of the concrete.
4) Optimum dosage of PEG for M40 grade of concrete is found to be 0.5%

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