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COMPARATIVE STUDY ON SELF-CURING CONCRETE BYUSINGVARIOUS ADMIXTURE

Akanksha Kumari[1], Akash Kumar Gupta[1], MD Hasan Raza[1],MD Sameer[1], Er Avinash kr. Upadhyay[2]

[1]Student Department of Civil Engineering Babu Banarasi Das Instituteof Technology and Management

[2]Assistant professor, Department of civil Engineering Babu Banarasi DasInstitute of Technology and Management

ABSTRACT

The aim of this investigation is to study the strength and durability properties of concrete using water solublepolyethylene glycol as self-curing agent.The function of self-curing agent isto reduce the water evaporation from concrete. The use of self-curingadmixtures is very important from the point of view that water resource saregettingvaluableeveryday.Polyethyleneglycolin1%, 1.5%and2%placeusingconcrete(i.e;each 1m3ofconcreterequiredabout3m3of waterforconstruction. Most of which is for curing Concrete are made up of M20 grade mix and tested for its compressive strength test, split tensile test and flexure test up to 7, 14 & 28 days of age and compared with conventional concrete.Hot climates prevail in many regions ofthe globe. The average summer temperature of hot arid areas is in therange of 40-50°C with temperaturesexceeding these values under direct solar radiation. Curing concrete in these regions may bechallengingduetolimitedavailabilityofsuitablewaterforcuringand/orrapidlossofc

uringwaterby evaporation. For many years self-curing admixtures were recommended as an alternative towater curing, however, limited studies have been conducted on their performance in hot weatherconditions.

Curing of concrete is the process of maintaining satisfactory moisture content in concrete during its early stages in order to develop the desired properties. However good curing is not always practical in many cases the present study deals with the effect of polyethylene glycol (PEG)and poly-vinyl alcohol (PVA) on concrete and their contribution to strength which are carried out. The effect of admixtures in mechanical characteristic of concrete i.e., compressive strength, split tensile strength and flexural strength by varying the percentage of PVA, PEG-200, PEG-400, PEG-600 from 0% to 1.5%

by weight of cement is studied for M30 grade of concrete and the optimum percentage of PEG and PVA in self curing concrete with conventional concrete with water curing is compared. The optimum percentage with PEG is coated with PVA and strength analysis is done. From the results it is analyzed that adding of PEG 600 will give more strength compared to PEG 200, PEG 400 and PVA and it is also observed that Coating of PVA made a very less impact in the strength of concrete.

This study reviews research experiences on developing an internal curing approach for high-performance concrete (HPC). Common materials have been used to produce the internal curing required to reduce self-desiccation in cement paste and will subsequently reduce the risks of developing cracks in hardened concrete. Furthermore, this study focuses on the behavior of HPC, including density, strength (compressive, splitting tensile, and flexural), shrinkage (autogenous and drying), and microstructure of hydrated cement paste. Results indicate that internal curing is more effective at a later age on splitting tensile and flexural strength than on compressive strength. Internal curing has enabled the interfacial transition zone increasingly compact and dense, thereby enhancing strength.

As water is becoming a scarce material day-by-day, there is an urgent need to save the water in making concrete and in constructions. Though water is being used in making concrete, its usage is high in the curing process. Curing is more necessary for gaining strength at the same time and lack of proper curing can badly affect the strength and durability of the concrete. When concrete is exposed to the environment evaporation of water takes place and loss of moisture will reduce the initial water-cement ratio which will result in the incomplete hydration of the cement and hence lowering the quality of the concrete.So the use of self-curing concrete admixtures is very important from the

point of view that saving of water is necessary everyday (each 1m3 of concrete requires 3m3 of water in construction, most of which is used for curing). This paper summaries the case study to evaluate the effect (strength and durability) of self-curing methods in self-curing concrete. In this study hardened propertiesof the concrete containing self-curing agents at various percentage is investigated and compared with the conventional concrete. From this study we have planned to perform the comparative experimental tests between self-curing concrete (both external self-curing and internal self- curing) by using PEG and conventional concrete for M25 grade.

1. INTRODUCTION

Water is most commonly and frequently used raw material in construction field for aspects such as mixing and curing. This natural resource is also one of the important commodities used in many industries as well as in day to day needs in human life. As a result of this, water is about to become scarce. If this situation prevails, then the cost construction will reach to a point where common man cannot afford to build a home. Hence to mitigate this water problem in construction field, self curing concrete came into existence. According to the ACI Code- 308 "the internal curing is the procedure which involves in the hydration of cement which takes place due to the availability of excessive internal water (which is not part of the mixing water)".

„Internal curing" is also known as 'Self Curing'. The Self curing concrete means that no labour work is required to provide water for concrete or even no external curing is required after placing, where the properties of this concrete are at least comparable to and even better than those of concrete with traditional curing. 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. By following the above- mentioned method, the complexity in making sure that effective curing procedures are carried out by the construction site in charges becomes very easy because the hydrophilic material such as liquid paraffin wax are used as curing composition in the component of concrete mix. Poly ethylene glycol of lower molecular weight is more efficient as a self-curing agent when compared to the Poly ethylene glycol of higher molecular weight. Low dosage of Poly ethylene glycol is more efficient for achieving self-curing concrete.

Internal curing provides a modern twist on good curing practice by providing water to the cementitious matrix after setting. Internal curing improves the performance of concrete by increasing the reaction of the cementitious materials. However, unlike conventional curing

that supplies water from the surface of concrete, internal curing provides curing water from the aggregates within the concrete (Figure 1). This is very beneficial since the depth that external water can penetrate is limited for any concrete, while internal curing water is dispersed throughout the depth of the concrete. In North America, this water-filled inclusion is typically an expanded lightweight aggregate, although superabsorbent polymers, cellulose fibers, or recycled concrete have been used (1, 2, 3). The water that is absorbed in the lightweight aggregate does not contribute to the classic definition of the water-to cement ratio. The water-to-cement ratio is a descriptor of structure of the matrix and pores that develop in the fluid concrete system. Once the concrete sets, the structure and pore network have been established, and water can only aid in hydration. The water in the lightweight aggregate will desorb (leave) the pores of the lightweight aggregate as the negative pressure in the pore fluid develops with setting and increases thereafter.

I. LITERATUREREVIEW

2.1 Mahanraj A (2016):

curingconcreteincorporate dwithpolyethyleneglycol".Thecompressiv estrength of cube for Self-cured concreteis higher than of concrete cured by conventional curingmethod. The split tensile strength of self-cured concrete specimen is higher than that of theconventionally cured specimen. Self- cured concrete is found to have less water absorption valuescompared with concrete cured by other methods. Self-cured concrete thus has a fewer amount ofporous.

2.2 Basil M Joseph (2016):

curingconcreteandPEG400wereusedasaself-M20grade of concrete is adopted for investigation. The author added 0-1.5% of PEG400 by weight ofcement for M20 grade concrete from that he found 1% of PEG400 by weight of cement wasoptimum for M20 grade of concrete for achieve good maximum strength. The author found thatthepercentageofPEG400getsincreased slumpaswellascompactionfactoralsoget increased.

2.3 Mousa M I (2015):

"In their study water retention and durability of concrete with or without alonglica fuself-curingagentssuchpolyethylene-

glycolandlecaisinvestigatedandcompare dtoconventionalconcrete. The concrete mass loss and the volumetric water absorption were measured, to evaluatethewaterretentionoftheinvestigat edconcrete.significantimprovementinallc onsideredconcretepropertiesduetotheadd itionof15%SFalongwithselfcuringagents hasbeenachieved,

especially with 2% of Polyethylene- glycol which absolutely ensured the best results and gooddurabilityproperties.

2.4 Shikha Tyagi (2015):

curingconcreteandhaduseP EG400asaself curingagentinconcrete".M2 5andM40gradeofconcreteareadoptedforin vestigation.Theauthoradded1-2%ofPEG400byweightof cement for M25 and M40 grade concrete. The author was determined that the optimum dosageof PEG400 for maximum Compressivestrength was to be 1% for M25 and 0.5%for M4O gradesofconcrete.

2.5 Dahyabhai (2014):

introducing on -curing the self concrete in construction industry". Compressive strengthof self-curing concrete is increased by applying self-curing admixtures. The optimum amount ofPEG600fo r maximumeffectivecompressivestrength wasfoundtobe1%ofweightofcementforM 25gradeofconcrete.Theoptimumamount ofPEG1500ofmaximumcompressivestre ngthwasfound to be 1% of weight ofcement for M25 grade of concrete. Self-curing concrete is the bestsolutionto theproblemfacedinthedesertregionandfac ed dueto lackofpropercuring.

METHEDOLOGY

Collection of Raw Materials: The materials used in this project are Ordinary Portland cement(OPC), Coarse aggregate, Fine aggregate, PEG-400(polyethylene glycol),glycerine easily availabe inmarket

3.1 OrdinaryPortlandCement(OPC): Or dinaryPortlandCement(OPC)isthemos tcommonlyand widely used cement inall over the world. It is manufactureas a powder by mixinglimestone andother raw materials which consist ofargillaceous, calcareous and gypsum. Inthisexperiment53gradeofOPCis used.

3.2 FineAggregate:Itisagranularmaterial whichisusedtoproduceconcreteormort arandwhentheparticlesofthegranularm aterialaresofinethattheypassthrougha4 .75mmISsieve,itiscalledfineaggregate.

3.3 Coarse aggregate: Aggregates which passes through 20mm IS sieve and retained on4.75mmISsieveare knownascoarseaggregate.Inthisproje,20mmsizeofcoarse aggregateisused

3.4 PEG-400 (polyethylene glycol):

Polyethylene glycol is a condensation polymer of ethylene oxide and water with general formula (OCH2CH2)nOH,where'n'isthea veragenumberofrepeatingofoxy-ethylenegroupstypicallyfrom 4 to about 180. The abbreviation (PEG) is term in combination with a numeric suffixwhichindicates the average molecularweight. One common feathers of PEGappear to be the water-soluble nature.Polyethylene glycol is non-toxic,odorless, neutral, lubricating, non-volatileandnon-irritatingis usedinavarietyofpharmaceuticals.

3.5 Glycerin

Adirectplasticizingeffectisproducedinmostapplicationsforglycerineas humectant-plasticizer because glycerin and water act together to promote softness and flexibility and topreventdrying out. These applications include promotes softness personal products such ascosmeticcreams,lotions,capsules,andden tifrices,andflexibilityediblessuchascandyandcoughdrops, cigarette tobacco, and industrial materials such as cellophane, paper products, cork andgasketcompounds,glues,textiles,andprintingsupplies.Theplasticizingeffect,however,ismorethan merely the result of glycerin's holding water.

1.6 Super absorbent polymer

Thesearechemicallysynthesizedhydrophilicpolymers.Asthenameitsselfsays,thechemicalisused to absorb the water in the formof inclusion. The word hydrophilic meanswater-lovingorattracting.Thehydrophilicpolymershavethebasictwocomponents,oneisorganicHydrophobiccarbonpartandtheotheristheinorganicpartwhichhelpstoattachwatermoleculeswithinit.Andthus, with the help of hydrophilic radicals, they form the hydrogel with the polymer. And thus,thewater remains attached but in undisturbed form. This undisturbed waterinclusion is used duringthehydrationprocessprovidingintercalcuring.Someofthehighlyprefersuperabsorbentpolymerare polyvalent alcohol, polyethylene glycol (PEG), poly-acrylicacid, xylitol, sorbitol, Glycerinphytosterols,hyaluronic,polyoxymethylene(POE),sodiumpyrrolidonecarboxylate,stearylalcohol,andurethanes.

IV Experimentalanalysis:

4.1 Compressive Strength:

Thecube specimens were tested oncompression tested machine ofcapacity 3000KN,bearingsurfaceofthemachinewa swipedoffcleanandsandorothermaterialre movedfromthesurfaceofthespecimen.Thi sspecimenwasplacedinmachineinsucham annerhattheloadwasappliedtotheopposite sidesofthecubesascastedThatis,nottopan dbottom. the axis of the specimen was carefully aligned at the center of the loading frame. the loadapplied was increased continuously at a constant rate until the resistance of the specimen to theincreasing load breaks down and no longer can be sustained.

The maximumloadappliedonspecimenwasrrd Was record

. **Table. 1**

	CompressivestrengthinMpa,			
Days	7days	14days	21days	8days
Conventional Concrete	20.76	27.15	28.74	31.94
Conventional concret+ Flyash	7.28	9.52	10.64	11.20

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4.2 Split Tensile Strength:

The cylinder specimen were tested on compression testingmachine of capacity3000KN. The bearing surface of machine was wipe off clean and losesother sand or other material removed from the surface of the specimen. the load applied wasincreasedcontinuouslyataconstantrat euntiltheresistanceofthespecimentothein creasingload breaks down and no longercan be sustained. The maximum load applied on specimenwasrecorded.fsplit=2P/3.14Dwhere p=load,D= diameterofthecylinder.

Table 4.2

	Split TensileStrengthinMpa,		
Days	7days	14days	28days
Conventional Concrete	1.42	1.86	2.18
ConventionalConcrete+ glycerin	1.13	1.48	1.74

Table 4.3

Percentage Varyig of PEG400	Split TensileStrengthinMpa,			
	7Days	14Days	21Days	28Days
0%	1.09	1.34	1.76	2.11
0.5%	1.25	1.53	1.82	2.39
1.0%	1.52	2.10	2.81	3.66
1.5%	1.41	1.74	2.23	2.81
2.0%	1.32	1.72	2.13	2.67

V CONCLUSION

-worldapplications,theself-curingprocessworksforbothnormalandself-compactingconcrete.

- Theuseofself-curingadmixturesimprovestheconcrete'sdurabilityandworkability.

Self-curing concrete has a better strength than traditional concrete with thesamemixdesigninalmostallcircums tances.

Self-curing concrete is the solution to a slew of problems caused by a lack of properconcrete curing.

Self-curing concrete is used in deserts and other areas where water scarcityis a seriousissue.

Self-curing concrete is employed in simple as well as complex buildings shape.Wherethereis

- anissuewithusinganotherwayofcure. The optimum dosages of PEG andPVA for different classes of concretewere determinedto be 0.5 percent to 1percent for maximal strength(compressive, tensile, andflexuralstrength).
- ThemechanicalqualitiesofSCconcrete weresignificantly enhancedwhen thetwochemical curing agents weremixed as 1.0 percent PEG400+0.01 percentPAM,comparedtoemployingeachPEG400orPAMaloneatallages.
- PEG two hundred affords the water tohydrate all of the cement, undertakingwhat thecombinationwateronmyowncannot doandthat`swhytheremaybeaboominelectricitypropertiesofself-curingconcrete.
- Theresultdeterminedoutfor specimenincorporatesPEG-200suggestsbetterenergythantraditionalmixesincompressive,splittensile,and flexuralstrengths.

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