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Use of Polyethylene Glycol as Self Curing Agent in High Grade concrete

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Abstract : Self Cured concrete is a type of concrete with a special ability to reduce autogenous shrinkage responsible for early stage cracking. different type of internal curing agents are currently being used around the world. Using Self curing concrete will lead to an escalation in the Strength of concrete Self Curing is beneficial in low water cement ratio concrete because of the chemical shrinkage that accompanies Portland cement hydration and low permeability of these material. Since the water incorporated into and absorbed by the cement hydration products has a specific volume less than that of bulk water a hydrating cement paste will imbibe water from available source. while in higher water cement ratio concrete this water can be and often is supplied by external curing. The present work deal with the results of experimental investigation on Polyethelene glycol 400. Effect of these Admixture on various Strength of concrete are studied.

Polyethylene glycol content varied from 1 to 3% by weight of cement. Various Strength are considered for investigation are Compressive Strength, Flexural Strength. Cube size 100mm for Compressive Strength, beam size 500x100x100mm for Flexural Strength were cast. all the specimen were Self Cured for 7 and 28 days and tested subsequently. The optimum measured quantity of PEG 400 for maximum Compressive and Flexural Strength was found 2 % for M60 grade concrete .

Various microstructure crack appear in a low water content specimen while Self curing process to overcome this problem of cracking Glass fibers and Silica Fume are used. The Compressive and Flexural Strength are increased at 2% when comparison of conventional curing of concrete. Study recommended suitable PEG 400 as an internal Self curing agent as it was completely soluble in water.

Key word : Self Curing ,Polyethylene Glycol , Strength, Glass Fibers, Silica Fume

1.Introduction

: Concrete Technology has been undergoing rapid development. Concrete is a heterogeneous construction material and its quality not only depend on raw material used but also depend on mixing compacting and curing. Concrete with internal curing is being evolved from the concept of Self Curing. In Recent years Self curing of concrete gain popularity. Self Curing concept emerged from United state by Paul Klieger in 1957. In the civil engineering concrete structures curing is the important factor for the Strength and durability of concrete.

Concrete Curing is a major challenge in construction industry especially in areas, which suffer from the shortage of water. Concrete structure should have ideal durability properties to provide better functionality during there lifetime. Concrete curing is important because they maintain the moisture content and temperature so properties of concrete might expand.

2. Material :

A. Cement : OPC (53) conforming to IS : 12269-1987

B. Fine Aggregate conforming to IS :383-1970

C. Course Aggregate conforming to IS :383-1970

D. Silica Fume

E. Glass Fibers

F. Polyethylene Glycol

G. Super plasticizer

Table 1:Cement properties.

Sr No.	Characteristics	Investigational value
1.	Soundness	1.4 mm
2.	Normal consistency	32%
3.	Initial setting time	62
4.	Final setting time	165
5.	Fineness	2.73%

Table 2:Fine Aggregate properties.

Sr No.	Characteristics	Investigational value
1.	Water absorption	1%
2.	Specific gravity	2.68
3.	Fineness range	2.43

Table 3: Coarse Aggregate properties.

Sr No.	Characteristics	Investigational value
1.	Water absorption	2.3%
2.	Specific gravity	2.60
3.	Fineness range	3.19
5.	Aggregate crushing value	16.92%
6.	Bulk density of aggregate	1727gm

Polyethylene Glycol : it is condensation polymer of ethylene oxide and water with the general formula H(OCH²CH2)nOH , where n is average number of repeating polyethylene groups typically from 4 to about 180 . one common feature of PEG appears to be the water soluble in nature. Polyethylenene glycol is non-toxic, odourless, neutral, lubricating, non-volatile and non- irritating and is used in a variety of pharmaceuticals. Thus it is shrinkage reducing admixture.

Table 4: Parameter of Polyethylene glycol

Sr No.	Discription	properties
1.	Density	1.13kg/cm^3
2.	p^H	5-7
3.	Color	It is colorless
5.	Acidity	0.05% max
6.	Boiling Point ^{0}C	>250
7.	Moisture	0.2%
8.	Molecular weight	400
9.	Appearance	Clear fluid
10.	Hydroxyl no	264 to 300
11.	Specific Gravity	1.12

Table 5 :Physical properties of Glass Fibers

Sr No.	Description	properties
1.	Fibers length	12mm
2.	Texture(gram/km)	82
3.	Moisture	0.5%
5.	Aspect ratio	888
6.	Electrical conductivity	Very low
7.	Chemical resistance	Very high

Table no 6 : Physical properties of Silica Fume

Sr No.	Description	properties
1	Specific gravity	2.2 to 2.3
2	Bulk density	0.82 g/m3
3	Oil absorption	26 g/100g
4	p^H	7
5	Hardness	7 Moh's
6	Minimum brightness	90

Table no 7. Physical properties of Polycarboxylate ether (Superplasticizer)

Sr No.	Description	properties
1	Specific gravity	1.110 to 0.02
2	solubility	Readily soluble in water
3	Chloride content	Below 0.02
4	Appearance	Deep brown coloured liquid
5	p^H	6.5 -8.5

3. Experiment :

3.1. Mix Design : ACI method of mix design was use for mix design of high-Strength concrete M60 grade of concrete. Quantity of water maintain constant as 144kg/m3 for all mix. Whereas dosage of super plasticizer is kept as 1% of cementious material for mix having w/c ratio 0.27. The quantities of ingredients materials and mix properties as per design are as follows:

Table no 3.1 Mix proportion of M60 grade concrete

Material	Proportion by Weight	Weight in Kg/m^3
Cement	1	531
F.A.	0.69	371
C.A.	1.56	830
W/C Ratio	0.27	144

3.2 Schedule of Specimen Preparation:

The specimens used were cubes, beam specimens and cube specimens specially prepared to measure Compressive Strength. Dimensions of each test specimen are as under:

Cube: 100mmx100mmx100mm

Beam: 100mmx100mmx500mm

Beam specimens were used to determine Flexural Strength, and Compressive Strength.

Cubes of 100 mm size were used to find the Compressive Strength.

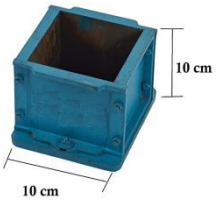

Figure no 3.1

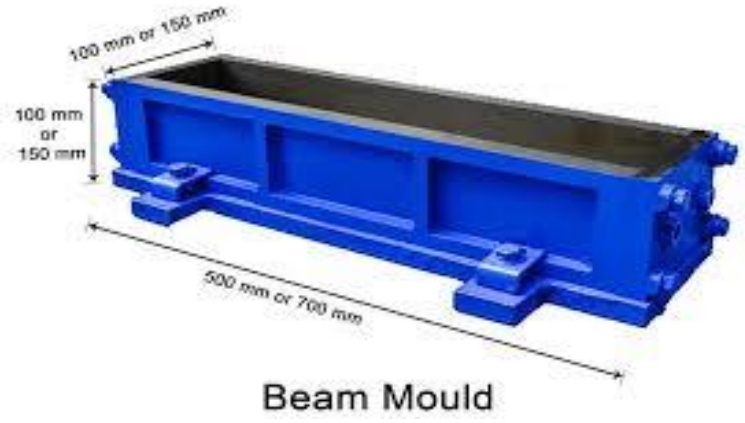

Figure no 3.2

Table no 3.2 Schedule of Specimen Preparation

Sr. no	Mix designation	Poly ethylene Glycol	Glass fibers	Silica Fume (%)	Admixture (%)	W/C ratio	Compression Test		Flexure test	
							7 days	28 days	7 days	28 days
1	M0	0%	2%	5%	1%	0.27	3	3	3 3	3
2	M1	1%	2%	5%	1%	0.27	3	3	3 3	3
3	M2	2%	2%	5%	1%	0.27	3	3	3 3	3
4	M3	3%	2%	5%	1%	0.27	3	3	3 3	3

4. Result and Discussion :

Mix	Compressive Strength	
	7 days	28 days
PEG 400 0%	35.45	63.96
PEG 400 1%	33.96	58.89
PEG 400 2%	38.66	72.89
PEG 400 3%	30.06	43.07

Figure 4.1 Variation of Compressive Strength of high Strength concrete at 7 & 28 days

Mix	Flexural Strength	
	7 days	28 days
PEG 400 0%	4.02	6.25
PEG 400 1%	4.19	6.28
PEG 400 2%	4.89	7.15
PEG 400 3%	4.48	5.06

Figure 4.2 Variation of Flexural Strength of high Strength concrete at 7 & 28 days

5. Conclusion :

On the basis of experimental test result and observation following conclusion are made:

The combinations of Silica Fume and Glass fibers in high Strength concrete improve the characteristic Strength of the Self curing concrete.

The highest characteristic Compressive Strength and Flexural Strength is achieved at 2% of Polyethylene Glycol on concrete .

The addition of 3% of Polyethylene Glycol in concrete, decreased in the Compressive Strength and flexural Strength of the concrete.

The Flexural Strength of the concrete was increases with increase in the percentage of Polyethylene Glycol. Up To 2% but when we increase in the percentage of Polyethylene Glycol at 3% the Compressive and Flexural Strength was decreases.

The chemical admixture namely namely Polyethylene Glycol (PEG) is able to reduce water evaporation by a retaining function, lead to strong and durable concrete without water curing but it is expensive

Study recommended that Polyethylene Glycol PEG 400 can used as internal curing agent for M60 grade concrete.

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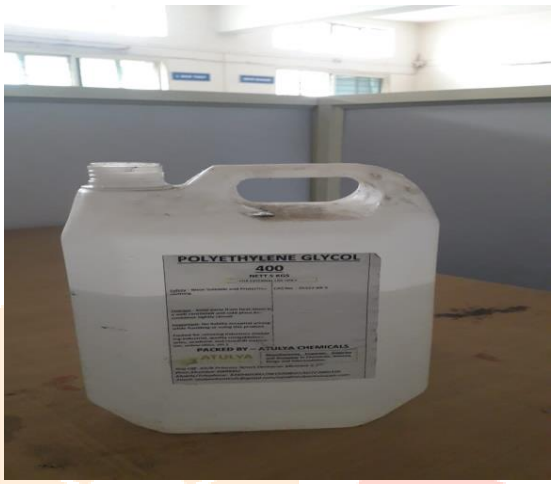

Polyethylene Glycol Liquid