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EXPERIMENTAL INVESTIGATION OF SELF CURING CONCRETE

M. POOVIZHISELVI[1], D.KARTHIK[2]

[1.] *Assistant Professor, Department of Civil Engineering, Tamilnadu College of Engineering, Coimbatore, Tamil Nadu, poovizhicivil@gmail.com*

[2.] *Assistant Professor, Department of Civil Engineering, KPR Institute of Engineering and Technology, Coimbatore, Tamil Nadu, karthikkdevaraj@gmail.com*

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ABSTRACT - *Concrete is most widely used construction material due to its good compressive strength and durability. Concrete can be cured by water curing and by self curing agent. Plain concrete needs congenial atmosphere by providing moisture for a minimum period of 28 days for good hydration and to attain desired strength. Self curing concrete is the one which can cure itself by retaining its moisture content. In the present study, the affect of admixture (PEG 400) on compressive strength, split tensile strength, flexural strength and durability test by varying the percentage of Polyethylene Glycol (PEG) by weight of cement from 0% to 2% were studied for M20 and M30 mixes. Super plasticizers are water reducers which are capable of reducing water content by about 30 percent. It was also found that 1% of PEG 400 by weight of cement was optimum for M20, while 0.5 % was optimum for M30 grade concretes for achieving maximum strength without compromising workability.*

Key words: Self curing, Polyethylene Glycol, Super plasticizers, compressive strength, split tensile strength, flexural strength

1. INTRODUCTION

1.1 Self Curing

Proper curing of concrete structures is important to meet performance and durability requirements. In conventional curing this is achieved by external curing applied after mixing, placing and finishing. Self-curing or internal curing is a technique that can be used to provide additional moisture in concrete for more effective hydration of cement and reduced self-desiccation. 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". The additional internal water is typically supplied by using relatively small amounts of saturated, light weight, Polyethylene Glycol, super absorbent polymer particles in the concrete.

1.2 Polyethylene Glycol

Polyethylene glycol is also known as polyethylene oxide (PEO) or polyoxyethylene (POE), depending on its molecular weight. The structure of PEG is commonly expressed as $H(OCH_2CH_2)_n$ OH, where n is the average number of repeating oxyethylene groups typically from 4 to about 180. One common feature of PEG appears to be the water-soluble nature. Polyethylene glycol is non-toxic, odourless, neutral, lubricating, non-volatile and non-irritating and is used in a variety of pharmaceuticals.

2. EXPERIMENTAL INVESTIGATIONS

2.1 Materials used:

Cement: Portland Pozzolana Cement (PPC-53 grade) conforming to IS: 8112-198986. The specific gravity of cement is 3.15

Fine aggregate: Locally available river sand conforming to Zone II of IS: 383- 19707 was used as fine aggregate with specific gravity 2.89

Coarse aggregate: 20mm size crushed granite stone obtained from the local quarry with specific gravity 2.69

Water: Potable tap water available in laboratory with pH value of 7.0± 1

Super plasticizer: Sulphonated naphthalene formaldehyde condensate type, CONPLAST SP430.

Polyethylene Glycol-400: Polyethylene glycol is a condensation polymer of ethylene oxide and water with the general formula H(OCH2CH2)n OH, where n is the average number of repeating oxyethylene groups typically from 4 to about 180.

2.2 Mix proportions:

The control mix was proportioned by IS 10262 : 2009 to obtain compressive strength of 40 MPa. The identification, mix proportion and quantity of material taken for one meter cube of self curing concrete mixes are given in Table 1.The mixes were obtained by adding PEG 400 content 0.5%,1%,1.5% and 2% of weight of cement .Additional water added to the mix depend upon the amount of PEG added. Super plasticizer CONPLAST SP430 is added 2% to the weight of binder.

2.3 Preparation, casting and testing of specimens:

The 150mm concrete cubes were tested for compressive strength at 28 days for M20 and M30 grade. All the test specimens were stored at room temperature and were kept for self curing.

Table 1 Mix Proportion Ratio per m³ for M20 grade

S.No	PEG -% of cement	Cement (kg)	PEG (kg)	Fine aggregate (kg)	Coarse aggregate (kg)	Water (lit)
Mix-1	0	383	0	546	1188	192
Mix-2	0.5	383	0.05	546	1188	223.5
Mix-3	1.0	383	0.10	546	1188	239.3
Mix-4	1.5	383	0.15	546	1188	255
Mix-5	2.0	383	0.20	546	1188	270.6

Table 2 Mix Proportion Ratio per m³ for M30 grade

S.No	PEG -% of cement	Cement (kg)	PEG (kg)	Fine aggregate (kg)	Coarse aggregate (kg)	Water (lit)
Mix-1	0	413	0	662	1140	186
Mix-2	0.5	413	0.05	662	1140	217.5
Mix-3	1.0	413	0.10	662	1140	233.3
Mix-4	1.5	413	0.15	662	1140	249
Mix-5	2.0	413	0.20	662	1140	264.6

2.4 EXPERIMENTAL PROGRAM

Mechanical properties studies were conducted at 28 days for M20 and M30 grade various mix to find the compressive strength, split tensile strength and flexural strength.

Compressive strength Test:

The test is carried out on 150x150x150 mm size cubes, as per IS: 516-1959. The test specimens are marked and removed from the moulds and unless required for test within 24 hrs, immediately submerged in clean fresh water and kept there until taken out just prior to test. A 2000 KN capacity Compression Testing Machine (CTM) is used to conduct the test. The specimen is placed between the steel plates of the CTM and load is applied at the rate of 140 Kg/Cm²/min and the failure load in kN is observed from the load indicator of the CTM.

Split tensile strength Test:

The cylinder specimens were tested on compression testing machine of capacity 3000KN.The bearing surface of machine was wiped off clean and looses other sand or other material removed from the surface of the specimen. The load applied was increased continuously at a constant rate until the resistance of the specimen to the increasing load breaks down and no longer can be sustained.

Flexural Strength Test:

The flexural strength of concrete prism was determined based on IS: 516 –1959. The specimen was placed in the machine in such a manner that the load is applied to the upper most surface as cast in the mould along two lines spaced 13.3cm a part at a rate of 180 kg/min and is increased until the sample fails.

3. RESULTS AND DISCUSSIONS

Mechanical properties studies conducted on self curing concrete namely compressive strength, split tensile strength and flexural strength and their results are discussed below.

Compressive Strength

The cube compressive strength results at the various ages such as 28 days for different percentage levels such as 0%, 0.5%, 1%, 1.5% and 2% (mix designations as NM, PEG 0.5 %, PEG 1%, PEG 1.5%, and PEG 2%) in Table 3. The development of Compressive Strength with ages for the above different mixes was plotted in the form of graphs as shown in Fig 1.

From the test results it was observed that the maximum compressive strength is obtained for mix (1% for M 20 and 0.5% for M 30). To maintain the workability of concrete mixes, the dosage of super plasticizer has to be increased.

Table 3 Compressive Strength Test Results at 28 days

S.NO	PEG	f_c at 28 days M20 (N/mm²)	f_c at 28 days M30 (N/mm²)
Mix-1	0%	26.60	46.79
Mix-2	0.5%	27.61	48.63
Mix-3	1%	28.50	45.17
Mix-4	1.5%	26.79	40.17
Mix-5	2%	25.06	38.33

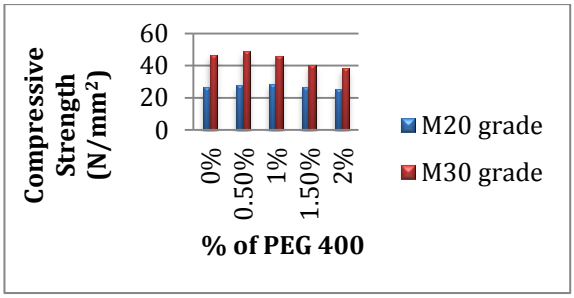

Fig 1 Compressive Strength for various replacement levels of PEG

Split Tensile Strength

The split tensile strength results at the various ages such as 28 days for different percentage levels such as 0%, 0.5%, 1%, 1.5% and 2% (mix designations as NM, PEG0.5%, PEG1%, PEG1.5%, and PEG2%) in Table 4. The development of Compressive Strength with ages for the above different mixes was plotted in the form of graphs as shown in Figure 2

Table 4 Split Tensile Strength Test Results at 28 days

S.NO	PEG	f_t at 28 day M20 (N/mm²)	f_t at 28 day M30 (N/mm²)
Mix-1	0%	1.81	3.32
Mix-2	0.5%	1.94	3.68
Mix-3	1%	2.05	3.54
Mix-4	1.5%	1.96	3.37
Mix-5	2%	1.83	3.18

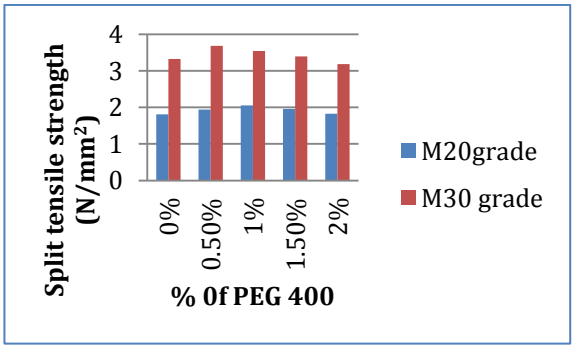

Fig 2 Split Tensile Strength for various replacement levels of PEG

Flexural Strength Test:

The flexural strength results at the various ages such as 28 days for different percentage levels such as 0%, 0.5%, 1%, 1.5% and 2% (mix designations as NM, PEG0.5%, PEG1%, PEG1.5%, and PEG2%) in Table 5. The development of Compressive Strength with ages for the above different mixes was plotted in the form of graphs as shown in Figure 3.

Table 5 Flexural Strength Test Results at 28 days

S.NO	PEG	M20 (N/mm²)	M30 (N/mm²)
Mix-1	0%	4.9	6.6
Mix-2	0.5%	4.8	7.5
Mix-3	1%	5.1	7.0
Mix-4	1.5%	4.7	6.8
Mix-5	2%	4.5	6.3

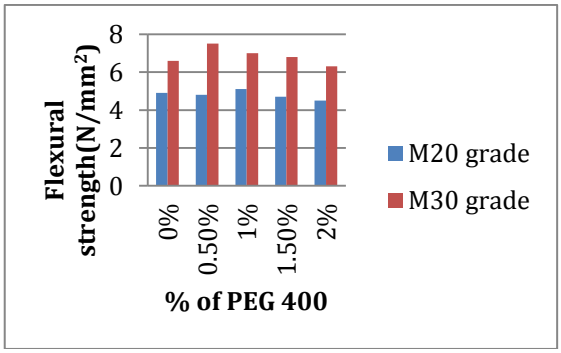

Fig 3 Flexural Strength for various replacement levels of PEG

4. CONCLUSION

The strength of self curing concrete the optimum dosage of PEG400 for maximum strengths (compressive, tensile and flexural strength) was found to be 1% for M20 and 0.5% for M30 grades of concrete.

- The strength and durability properties of internally cured concrete with PEG prove to be best among the alternatives percentage and prove to be the best when compared to external curing.
- Strength of self curing concrete is on par with conventional concrete.
- While considering the internal curing with that of external curing, the cost of internal curing proves to be cheaper when compared with that of external curing.
- Performance of the self-curing agent will be affected by the mix proportions mainly the cement content and the w/c ratio.

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