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Experimental Investigation on Mechanical Properties of Self Curing High Strength Concrete

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ABSTRACT

Concrete is very important in construction industries. For a well developed country we need industrial buildings, residential building, educational building business building, bridges, culverts, dams etc. To construct such structures concrete is most required material. Now-a- day's large amount of concrete is producing for constructions. For mixing of concrete water is mandatory without water we can't mix the concrete. The concrete is mixed along with polyethylene glycol in the range 0.5%-1% additionally mixed with admixtures like super plasticizer and silica fume which give more strength and workability for the concrete. In this study involves along with concrete the admixture polyethylene glycol (PEG4000) is added. The affect of adding (PEG 4000) on compressive strength, split tensile test, and modulus of elasticity by different percentage of PEG i.e.(0.5%, 1%, 1.5%) were studied for M70 and M80 grades.By observing the results that the optimum dosage age of PEG is 1% for both M70 and M80 grades. When compared with conventional concrete strength wise self curing concrete achieving maximum strength and also don't required water for hydration of concrete.

Keywords: Mechanical properties, High strength concrete, split tensile strength, compressive strength, Modulus of elasticity.

I. INTRODUCTION

Cement, water, and aggregates (like sand, pebbles, or pulverised stone) are combined to create concrete, a composite substance that solidifies over time. Building foundations, walls, floors, and walkways are just a few of the many things it is used for in construction. Typically, limestone, clay, and other minerals are heated to high temps in a kiln to create a fine powder that is used as cement in concrete.

The cement undergoes a chemical reaction when combined with water to create a paste that fuses the rocks together to form a sturdy and long-lasting substance. Regarding this project, I used ordinary Portland cement and self-curing concrete, which means that water, will keep the concrete in place. The self-curing concrete chemical I've used is polyethylene glycol PEG (4000). Self-curing concrete is a type of concrete that can cure or harden without requiring external water or moisture. Typically, concrete needs to be cured by adding water to it, and then keeping the concrete moist for several days to ensure that it sets and hardens properly. However, self-curing concrete uses special additives that can react with the water that is already present in the concrete mixture, or with the moisture in the surrounding air, to trigger the curing process.

Self-curing concrete is particularly useful in areas where water is scarce, or where it is difficult to maintain a consistent moisture level during the curing process. By eliminating the need for external water or moisture, self-curing concrete can save time, money, and resources, while still ensuring that the concrete sets and hardens properly.

II. LITERATURE REVIEW

Ms. Arpitha.A et.al (2021) As they indicated, the ideal PEG-400 dose for grade concrete was found to be 1% for maximal strengths (compressive, tensile). The percentage of PEG-400 also gets increased slump value. The self curing concrete improved the workability.

Vedant P. Chavan (2020) The amount of water being used, rather wasted can be efficiently saved and a minimal amount of water usage can be achieved on the construction sites. The concrete can prove economical over ordinary concrete as it is helping to save water.

L. kalaivani et.al (2020) It was discovered that 1.5% PEG400 dose was ideal for achieving the highest compressive tensile and rupture modulus strengths. Slump and compaction factor both increase with increasing PEG400 %.Concrete that cures on its own is a practical solution to numerous issues that arise from improper curing.

M V Jagannadhakumar et.al (2018) The optimum dosage of polyethylene glycol (PEG) for M20, M40 and M60 grades self curing concrete are 1%, 0.5% and 0.5% respectively. There is a significant increase in the compressive, split tensile and flexural strength properties self curing concrete mixes at all ages of curing when compared to normal externally cured concrete mixes. It was found that there is significant cost saving ranging from Rs. 2500-3000 per cubic meter of concrete if concrete is internally cured.

Prakash mandiwal et.al (2018) The maximum strength achieved by the PEG 400 is found to be 1.6% for Mix-25 and 2.4% for Mix-20 grade. The concrete strength gaining by the PEG400 is comparable for M25 & M20 mix.

OBJECTIVES AND SCOPE OF INVESTIGATION

The objective of self-curing concrete is to reduce or eliminate the need for external curing methods, such as wetting or covering the concrete surface with curing compounds, to ensure proper hydration and strength development of the concrete. Self-curing concrete typically contains special admixtures that release moisture within the concrete, which helps to maintain a moist environment for the concrete to cure properly.High-rise structures may be built using self-curing concrete because it eliminates the need for labour- and time-intensive external curing techniques. Concrete pavements can be built using self-curing concrete, where sturdiness and little cracking are crucial for maintaining the longevity of the pavement.

III. EXPERIMENTALINVESTIGATION

COMPRESSION TEST:

Prepare the concrete mixture with the desired proportion of ingredients, including the PEG 4000 as a self-curing agent. Mix the ingredients thoroughly to ensure uniformity. Pour the mixture into the cube moulds of standard size (10x10x10), ensuring that the moulds are properly cleaned and coated with a thin layer of oil or release agent to prevent the concrete from sticking to the moulds.Use an appropriate compaction instrument, such as a vibrating table or a hand-held tamping rod, to compact the concrete in the moulds. Make sure the concrete surface is level and the compaction is uniform. Cure the concrete cubes in room temperature for the specified curing period, which is typically 7, 14, 28 and 56 days. After the specified curing period, place the cubes in the compression testing machine and align them with the loading axis. Apply a load gradually on the cubes until they fail. Record the maximum load applied.

Fig1: Compression Test

SPLIT TENSILE STRENGTH TEST:

Prepare the concrete specimen according to the desired dimensions and with the appropriate amount of PEG4000 added to the mix. After casting the specimen, allow it to cure in a controlled environment for a set amount of time. This curing process allows the concrete to gain strength and helps to ensure that the concrete is fully hydrated. Once the curing process is complete, prepare the specimen for testing. The test is conducted by applying a compressive load to the specimen along its length until it fractures. The force required to fracture the specimen is measured using a load cell, and the tensile strength of the concrete is calculated by using T= $\frac{2P}{\pi LD}$. Repeat the procedure for at least three cylinders and take the average of the split tensile test values.

Fig2: Split Tensile Test

IV. RESULTS AND ANALYSIS

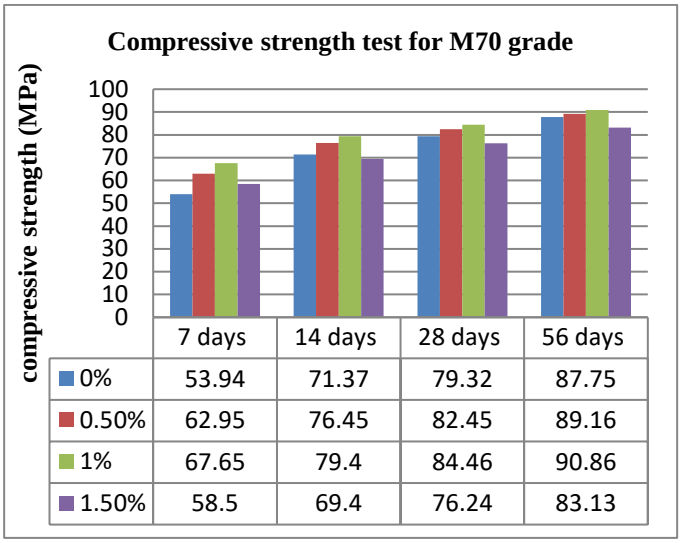
Compression Strength Test:

After completion of experimental test the obtained results for M70 and M80 are shown in below tabulations and also represented in graphs.

Table 1: Evaluating the compressive strength of concrete with Silica fume and Polyethylene Glycol (PEG-4000) for M70 grade.

Type ofconcrete	Grade ofmix	Range ofPolyethyleneglycol (%)	Days			
			7 days	14 days	28 days	56 days
ConventionalConcrete	M70	0	53.94	71.37	79.32	87.75

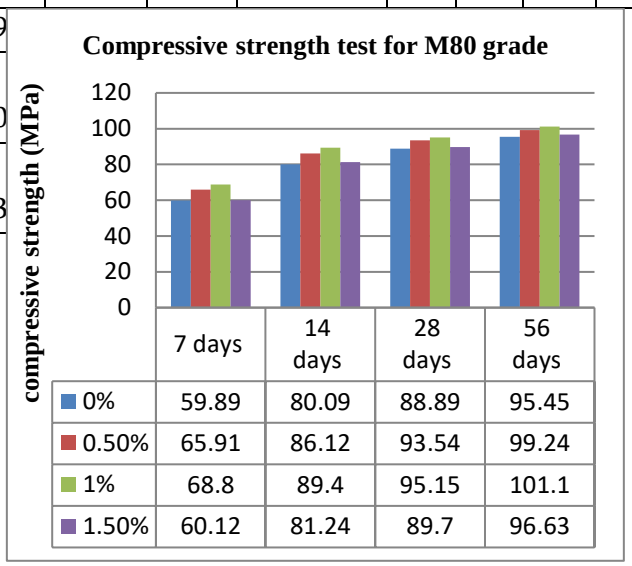
PolyethyleneGlycol (PEG-4000)	M70	0.5	62.95	76.45	82.45	89					4		
		1	67.65	79.4	84.46	90							
		1.5	58.5	69.4	76.24	83							



Graph 2: Compressive strength

Table 2: Concrete's compressive strength in comparison to Silica fume and Polyethylene Glycol (PEG-4000).

Type ofconcrete	Grade ofmix	Range of Polyethyleneglycol (%)	Days			
			7 days	14 days	28 days	56 days
Conventional Concrete	M80	0	59.89	80.09	88.89	95.45
PolyethyleneGlycol (PEG-4000)	M80	0.5	65.91	86.12	93.54	99.24
		1	68.80	89.40	95.15	101.1
		1.5	60.12	81.2	89.70	96.63



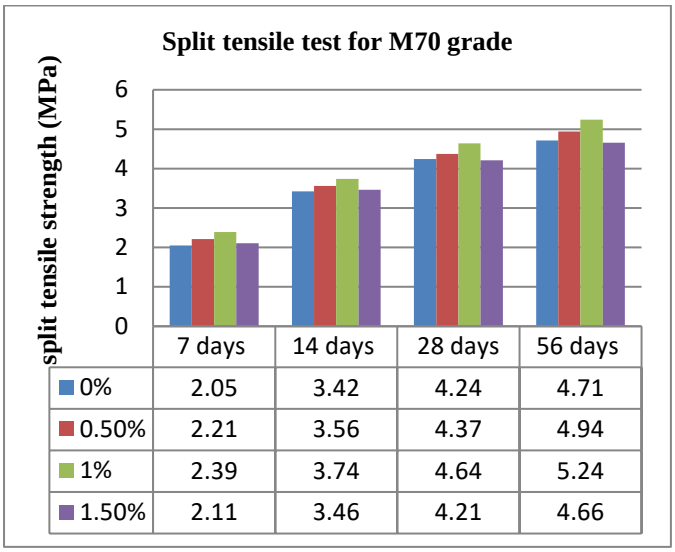
Graph 3: Compressive strength

Split Tensile Strength Test:

The following results for split tensile test are mention below table and graphs for M70 and M80.

Table 3: A comparison of the concrete's split tensile test with Silica fume and Polyethylene glycol (PEG 4000) for M70.

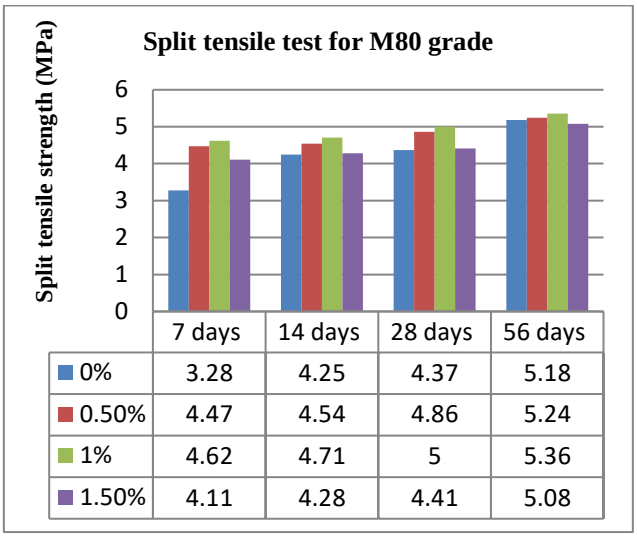
Typeof concrete	Grade of mix	Range of Polyethyleneglycol(%)	Days			
			7 days	14 days	28 days	56 days
ConventionalConcrete	M70	0	2.05	3.42	4.24	4.71
Polyethyleneglycol (PEG-4000)	M70	0.5	2.21	3.56	4.37	4.94
		1	2.39	3.74	4.64	5.24
		1.5	2.11	3.46	4.21	4.66



Graph 4 Split tensile test

Table:4Concrete's split tensile strength in comparison to silica fume and polyethylene glycol (PEG-4000) for M80.

Typeofconcrete	Grade of mix	Range of Polyethyleneglycol(%)	Days			
			7 days	14 days	28 days	56 days
ConventionalConcrete	M80	0	3.28	4.25	4.37	5.18
Polyethylene glycol (PEG-4000)	M80	0.5	4.47	4.54	4.86	5.24
		1	4.62	4.71	5.00	5.36
		1.5	4.11	4.28	4.41	5.08



Graph 5 Split tensile test

V. CONCLUSION

- For both M70 and M80 grades, 1% is the recommended polyethylene glycol (PEG 4000) dose percentage.
- The preferred amount of polyethylene glycol (PEG 4000) for 56 days of curing is 90.41 MPa and 101.10 MPa, respectively, based on the compressive strength values for M70 and M80 grade. Self-curing concrete has a higher compressive strength than traditional concrete.
- The split tensile value for M70 and M80 grade for 1% dosage of polyethylene glycol (PEG4000) about 56 days curing period is 5.23MPa and 5.36MPa respectively. When compared with conventional concrete 0.53% for M70 grade and 0.18% for M80 grade increased for self curing concrete.

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