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Experimental Analysis of PEG-400 as Self Curing Agent in Self Curing Concrete

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ABSTRACT

Concrete is the most extensively utilized construction material because of its well-known qualities, the most notable of which are durability, compressive, and tensile strength. Normal concrete, when used normally, requires a 28-day curing period in order to achieve its goal strength. This is necessary to avoid insufficient concrete specifications. Curing, as well as preventing evaporation from the surface, are both required for high-quality concrete. Self-curing concrete is a type of concrete that has been employed in recent years and provides efficient hydration to itself, making it a unique concrete. PEG-400 has employed this approach in this research effort, where cement is replaced in different percentages (0, 0.8, 1.6, 2.4, and 3.2) and the strength and durability of concrete is calculated. The maximum tensile strength achieved in PEG-400 for Mix-20 concrete is 1.6 percent, while the maximum strength achieved in PEG-400 for Mix-25 concrete is 2.4 percent. When the PEG-400 chemical is not utilized in traditional concrete, it loses 12.24 percent of its compressive strength for M25 grade concrete and 11.35 percent for M20 grade concrete when exposed to acid.

INTRODUTION

Concrete curing is important in the early stages because it keeps the wetness at bay. Curing is an essential aspect in the strength and durability of concrete structures in civil engineering. Extra internal water is frequently provided by a small amount of saturated, lightweight polyethylene Glycol, hyper absorbent chemical compound particles within the concrete. If this water is not correctly supplied, for example, due to capillary body non-percolation, vital autogenic deformation and (early-age) cracking may occur. As a result, chemical shrinkage occurs during the hydration of cement. Concrete curing is vital in the early phases because it keeps the moisture content and temperature stable, allowing the concrete characteristics to grow. In comparison to traditional concrete, polyethylene glycol helps to reduce water loss and improve water preservation capacity. The loss of water in the concrete is reduced with the help of PEG-400, and the water capacity of the concrete is improved when compared to conventional concrete. In concrete buildings, curing is necessary for optimal strength and durability. The strength of conventional concrete is acquired through external curing, which is achieved through careful mixing and placement of the concrete.

Self Curing Concrete and its necessity

Since it has been established that proper hydration of cement concrete structures is critical for meeting durability requirements. External curing, which involves spraying water onto the concrete surface, can provide normal hydration. Self-curing, also known as internal curing, is a method of hydration of cement in concrete that does not require a lot of moisture and reduces self-evaporation.
The demand for normal water (internal and external) is substantially higher in cement concrete while the reaction of mineralized additive is taking place. Concrete will not bond its elements correctly if this hydration demand is not met, and early stage cracks will form. To offset the damage, additional water must be added to the combination above the typical need. As a result, self-curing is required.

PEG - 400

Polythene glycol is a condensation chemical product of ethene and water with the general formula H (OCH2 CH2) n American state, where n is the average number of continuation of ethylene groups, which typically ranges from four to one hundred eighty. It appears to be soluble in water. It's both non-toxic and odorless.

Uses of PEG – 400

Polyethylene glycol's principal function is to hold water particles in any mixture in which it is employed. Furthermore, when this material is mixed with any other chemical, it is utilized to hydrate internally. The following are some of the most common applications of polyethylene glycol in construction:.

1. Soil stabilization, when soil has dumped and requires settling as fast it can.
2. Self-curing concrete, to hydrate itself.
3. Internal curing of foundation by hydration.
4. Concrete used in deserts where water required for curing is very less.
5. Water repellent concrete, to cure the concrete internally without disturbing the property of the same.
6. Metal matrix composites.
7. Used as seasoning of timber before used for construction purpose.
8. Used as a catalyst for binding materials in ceramics.
9. Waste treatment and stabilization and Embankment coats.
10. Fly ash-based cement-concrete bricks.
11. Concrete paving blocks, to cure without external curing.

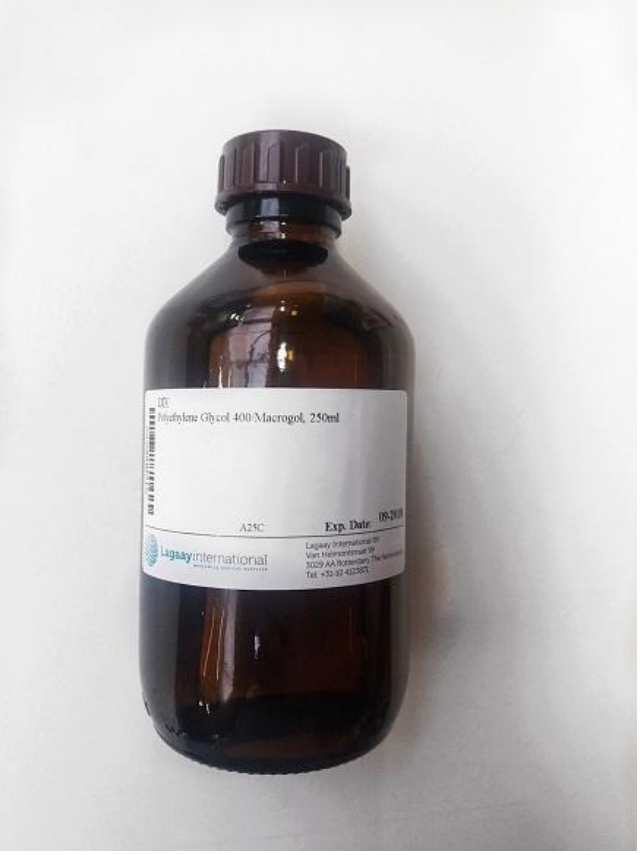

Fig 1: Condensed Polyethylene glycol

Project Objective

In this investigational process following are the key objectives of study-

1. To determine and compare the compressive strength on beams by performing tests on general M20 and percentage replaced PEG 400 based on concrete.
2. To determine and compare the split tensile strength of concrete cylinders by performing tests on general M20 and percentage replaced PEG 400 based on concrete.
3. To determine and compare the flexural strength on beams by performing tests on general M20 and percentage replaced PEG 400 based on concrete.
4. comparative study of the behavior of the general concrete with and without PEG-400.
5. To perform the advanced parametric analysis of members made up of PEG-400 using design software

6. To find the minimum percentage of PEG – 400 for finding the maximum strength of concrete.
7.To investigate strength enhancement by conducting a durability test on cubes and to describe the durability attributes of concrete of the M20 and M25 grades, both with and without concrete replacement.

RESULT AND DISCUSSION

Test of Compressive Strength: Compressive strength is determined by casting a minimum of three cubes in each batch mix. The specimens are tested when they reach the age of 28 days. Specimens are loaded into the test machine according to IS: 516-1959 clause number 5.5.1 page no 11 and placed in the machine according to the same IS code.

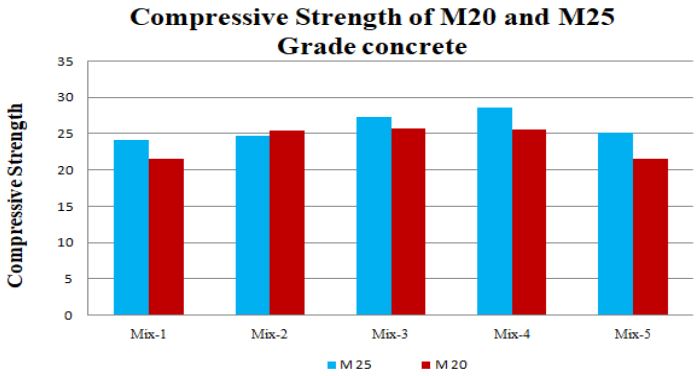

Fig -1: Graphical Representation of Compressive Strength in N/mm^2 for M20 and M25 Grade

Flexural strength: Beams of size 10cm*10cm*50cm are casted for determining flexural strength. Test on beams are performed at the age of 28 days of the specimen. Placement of specimen in machine is done as per IS: 516-1959 in the clauseno8.3.1pageno17.Load is applied at increasing rate of 108 KN/min. Load is applied until specimen fails and load at which specimen fails is recorded. As specified in the IS code flexural strength is calculated below.

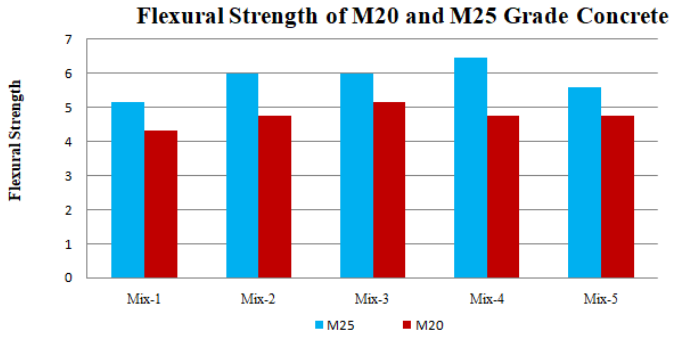

Fig -2: Graphical Representation of Flexural Strength in N/mm^2 for M20 and M25 Grade

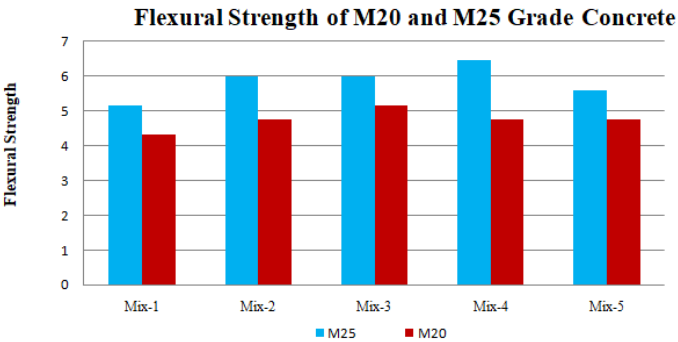

Fig -3: Graphical Representation of Flexural Strength in N/mm^2 for 28 Days

SPLIT TENSILE STRENGTH TEST

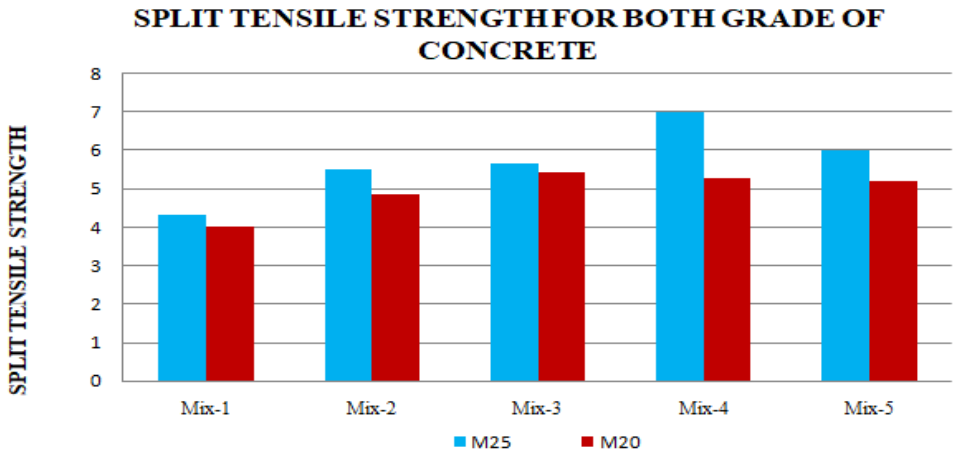

Fig 4: Split Tensile Strength in N/mm^2 at various percentages

Durability Test: The mass loss and strength of specimen due to acid attack was determined and the result of loss in compressive strength are below:-

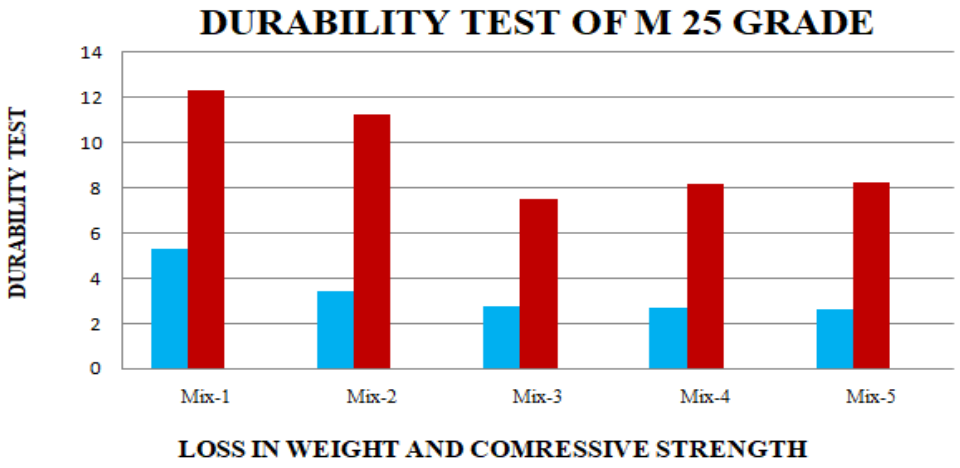

Fig 5: Graphical representation of durability test for Mix-25

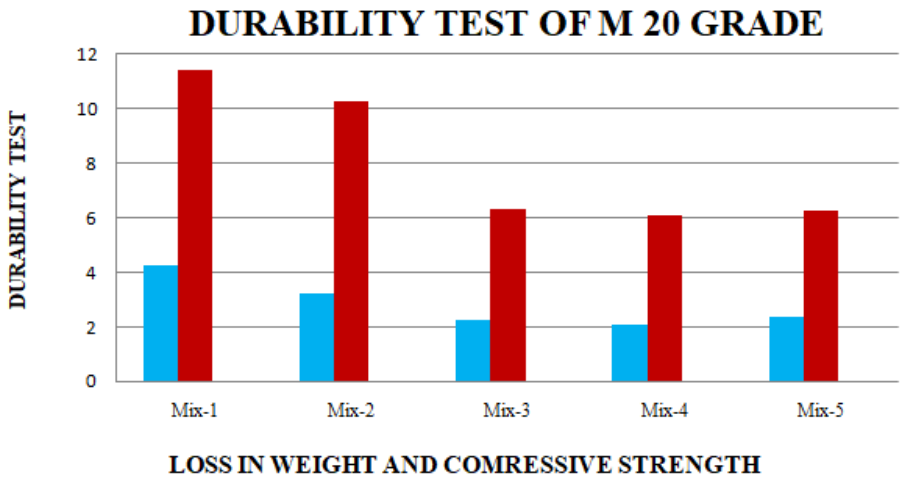

Fig 6: Graphical representation of durability test for Mix-20

CONCLUSION OF THE WORK

From the results which are elaborated in previous chapter, it is concluded that the PEG 400 is a superior replacement of cement.

1. The results achieved from the existing study shows that Polyethylene Glycol has a great potential for the utilization in concrete as substitution of cement only by 1.6 % to achieve good results.

2. Workability of concrete increases as proportion of PEG 400 chemical increases.

3. Maximum compressive power increased when the substitution of PEG 400 is about 1.6% for M 20 grade of concrete. It has also been evaluated that maximum compressive power increased when the substitution of PEG 400 is about 2.4 % for M 25 grade of concrete.

4. Maximum flexural strength increased when the substitution of PEG 400 is about 1.6% for M 20 grade of concrete. It has also been observed that maximum flexural strength increased when the substitution of PEG 400 is about 2.4 % for M 25 grade of concrete.

5. Maximum split tensile strength increased when the substitution of PEG 400 is about 1.6% for M 20 grade of concrete. It has also been observed that maximum split tensile strength increased when the substitution of PEG 400 is about 2.4 % for M 25 grade of concrete.

6. By conducting durability test, it has been found that loss in weight with minimum loss in compressive strength found to be in 2.4 % replacement by cement for both M 20 and M 25 grade concrete.

FUTURE SCOPES

Polyethylene Glycol has proved to be a better admixture and as a partial replacer of cement in concrete. Following future scopes can also be done in future for extending this work are as follows:-

1. The actual percentage of PEG in concrete up to the exact value has not been determined till now can be determined.

2. This work is done only in nominal mix of concrete, can be further extended for mix design for various grades of concrete.

3. Only 28 days strength test result has been used in this work, can be extended for 7, 14 and 28 days with comparison among these.

4. In market, there would be a replacement of the PEG 400 chemical, should be found and can be used for above test approaches.

5. A comparison approach for cost can also be a great work in this structural engineering field.

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