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Tensile Strength & Durability Study on Self-Curing Concrete as a Partial Replacement of Cement by PEG-400

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Abstract: The most widely used construction material, Concrete is famous for its famous properties, major of them are durability, compressive and tensile strength. Normal concrete which is used conventionally, to complete its target strength, requires curing period of 28 days because it is essential to prevent insufficient parameters of concrete. To achieve good quality concrete, curing must be essential along with evaporation from the surface need to be prevented. Self-curing concrete is one which has been used now a days which provide efficient hydration to itself that makes it an extraordinary concrete. By using this idea PEG-400 has used in this research work by which cement is replaced in different percentages (0, 0.8, 1.6, 2.4, and 3.2) & calculates the strength & durability of concrete. For Mix-20 concrete the maximum tensile strength achieved in PEG-400 is1.6% & for Mix-25 concrete the maximum strength is achieved in PEG-400 is 2.4%. For durability against acid attack, PEG-400 chemical when not used in conventional concrete, the loss in compressive strength is observed 12.24 percent for M25 grade concrete and 11.35 percentage for M20 grade concrete.

Keywords — cement replacement, durability test, loss in compressive strength, PEG-400, self-curing concrete, split tensile test.

I. INTRODUCTION

During the early stages concrete curing is significant for the reason that sustains the dampness. By the help of PEG-400 the loss of water in the concrete decreases and improves the capacity of water evaluate to normal concrete. For the good strength and durability curing is essential in the concrete structures. The strength is achieved in the normal concrete by the external curing because of proper mixing & placing of the concrete.

Self-curing and its necessity

Since it had been predefined that appropriate hydration of cement concrete constructions is very essential to achieve durability criteria. Normal hydration can be done by external curing by providing water onto the concrete surface. Self-curing is sometimes known as internal curing is a technique that will not require much dampness in concrete for simpler hydration of cement and minimize self-evaporation.

In cement, when reaction of mineralized admixture is going on, the demand for normal water (internal and external) requirement is much larger in cement concrete. If this hydration demand cannot be fulfilled, concrete will not bond its ingredients properly and the early stage cracks will appear. Therefore, it is necessary to provide the water to the mixture above the normal demand to counteract the damage. Therefore self-curing is necessary.

Process of internal curing

Since water evaporates continuously from the exposed surface which mainly consist of hydrogen and oxygen. The addition of polymers in concrete forms hydrogen bonds with water molecules that lessen the chemical reaction and reducing the evaporation rate from the surface of the concrete. This free hydrogen then combine with oxygen which is freely moving in atmosphere, makes water. Hence the water demand will be fulfilled and this is the process of internal curing.

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II. PROJECT OBJECTIVES

1) For improving the concrete using PEG-400.
2) Determine the tensile strength & durability of concrete using PEG-400.
3) To conclude the results of tensile strength & Durability of conventional concrete & self-curing concrete.

III. MATERIALS AND METHODOLOGY

Cement: For the design mix purpose Ordinary Portland Cement is used. The chemical compositions of cement are shown in table below:-

Table 1: Chemical composition of cement

Chemical Composition	Percentage
Cao	Sixty to Sixty seven percentage
Sio2	Seventeen to Twenty Five Percentage
Al2O3	Three to Eight Percentage
Fe2O3	Zero point Five to Three Percentage
Mgo	Zero point one to six Percentage
SO3	One to Three Percentage
Soda & Potash	Zero point Five to Three Percentage

Sand: It is collected from fine rock stone particles. It is defined by size, being finer than gravel and coarser than silt. Sand may also consign to a textural class of soil or soil type; i.e. a soil contain more than 85% sand-sized particle (by mass).

Coarse aggregate: They are found in many areas of the construction industry. It is very important material which is used in the construction. The size of aggregate is 10-20 mm used in the construction purpose.

Polyethene glycol (PEG): Polythene glycol commonly known as PEG is a chemical normally used in concrete in powder form, which is soluble in water. It is well known as a shrinkage reducing admixture used in concrete. PEG seems to be nontoxic, have mild odor and having density of 1.13 g/cm³. The polyethylene-glycol when added to concrete increases the water holding capacity in concrete and increases the compressive strength property. The PEG-400 used for this research.

IV. EXPERIMENTAL APPROACH

Split Tensile Strength Test: As we talk about casting of cylinders for determining split tensile strength of concrete, according to IS 5816, standard size of test specimen should be 15cm diameter and 30cm height. During casting of cylinders IS standards were kept in mind and mixing of materials, proportioning and preparation of mould is done IS 5816 - 1970. Same mix proportion is adopted for cylinder casting as adopted in casting of cubes & beams, fine aggregates and coarse aggregates respectively.

Figure 1: Compression testing machine

Figure 2: Testing specimen (Cylinder)

Figure 3: Applied load on cylinder

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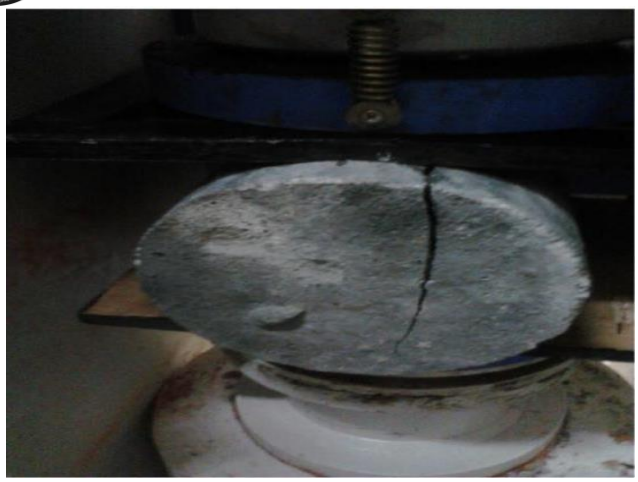


Figure 4: Failure of Cylinder

Durability Test & Resistance against Acid Attack: An investigational program was carried out to find out the strength and durability characteristic of concrete containing PEG-400 chemical. Concrete mix for M-25 & M-20 grade was designed, which served as basic control mix. PEG-400 concrete mixes were obtained by adding Polyethene glycol- 400 to basic control mix in percentages varying from 0 to 3.2% at an increment of 0.8% by weight of cement. The samples are cast and curing in the mould for 24 hours, after 24 hours, every sample are remolded and kept in curing tank for 28 days. After 28-days all specimens are kept in environment for 2-days for constant weight, then, the specimens are weighing and immersed in 5% sulfuric acid (H_2SO_4) solution for 28-days. The pH value of the acidic medium was at 0.3. After 28-days of immersing in acid solution, the specimens are taken out and were washed in consecutively water and kept in environment for 2-day for constant weight. Then the specimens are weighed and loss in weight and hence the percentage loss of weight was calculated.

The cubes of size 150*150 *150 mm are then tested in the CTM in a uniform rate of loading 140Kg/cm^2 as per IS 516. The loss of weight and strength of cubes due to acid attack are determined.

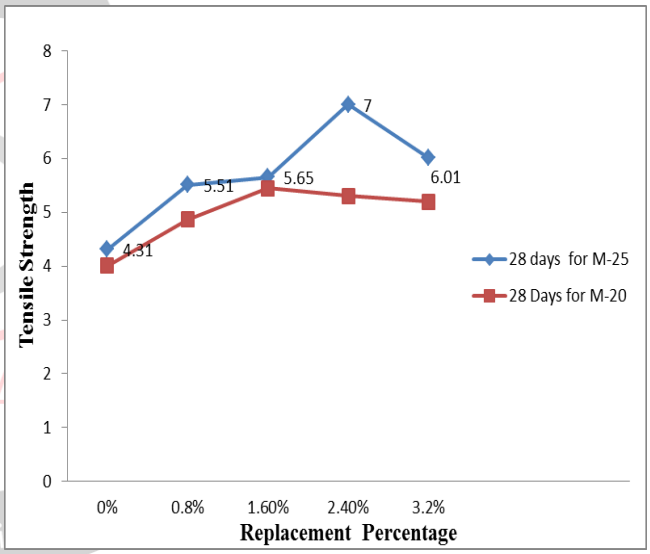
Figure 5: Specimen tested in compression testing machine

V. RESULTS

Split Tensile Strength Test: Cylinders are tested and Split Tensile Strength is calculated and tabulated below:-

Table 2: Result of Tensile Test

Batch Mixes	Batch Mix-A	Batch Mix-B	Batch Mix-C	Batch Mix-D	Batch Mix-E
PEG 400 % Replacement in cement	0 %	0.8 %	1.6 %	2.4 %	3.2 %
Tensile Strength observed (N/mm^2) for 28 days in M 25 grade concrete	4.31	5.51	5.65	7.00	6.01
Tensile Strength observed (N/mm^2) for 28 days in M 20 grade concrete	4.01	4.87	5.45	5.3	5.2



Graph 1: 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 tabulated below:-

Table 3: Results of Durability Test for Mix-25

Batch Mixes	Batch Mix-A	Batch Mix-B	Batch Mix-C	Batch Mix-D	Batch Mix-E
PEG 400 % Replacement in cement	0 %	0.8 %	1.6 %	2.4 %	3.2 %
% Loss in weight (at 28 Days)	5.3 %	3.4 %	2.74 %	2.64 %	2.63 %

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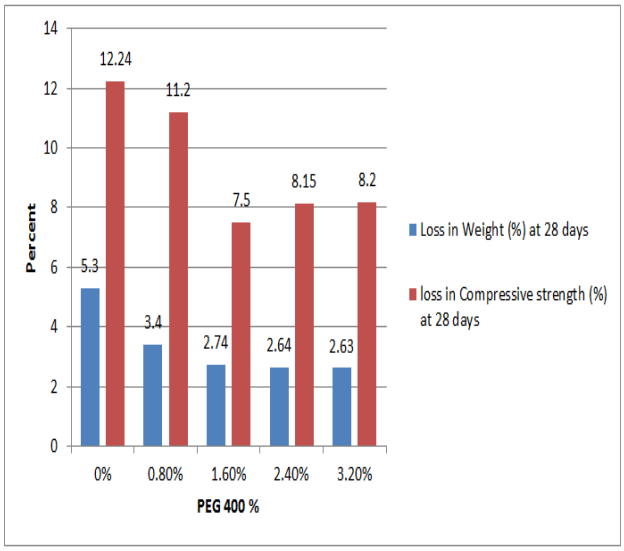
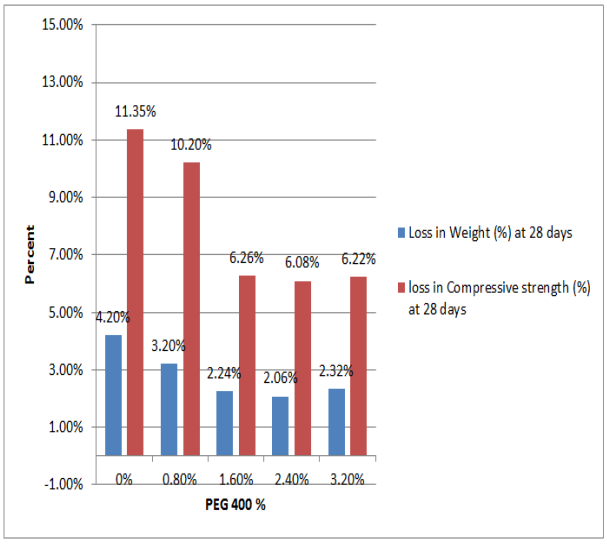
% Loss in Compressive strength (at 28 days)	12.24 %	11.20 %	7.50 %	8.15 %	8.20 %

Table 4: Results of Durability Test for Mix-20

Batch Mixes	Batch Mix-A	Batch Mix-B	Batch Mix-C	Batch Mix-D	Batch Mix-E
PEG 400 % Replacement in cement	0 %	0.8 %	1.6 %	2.4 %	3.2 %
% Loss in weight (at 28 Days)	4.2 %	3.2 %	2.24 %	2.06 %	2.32 %
% Loss in Compressive strength (at 28 days)	11.35 %	10.20 %	6.26 %	6.08 %	6.22 %



Graph 2: Graphical representation of durability test for Mix-25



Graph 3: Graphical representation of durability test for Mix-20

VI. Conclusion

1. From the above result the Optimum tensile strength is achieved by PEG-400 is found 2.4 percent for the mix-25 & 1.6% for Mix-20.

2. When PEG-400 was not used, the loss in compressive strength is observed 12.24 percent for M25 grade concrete and 11.35 percentage for M20 grade concrete concluding that the addition of PEG- 400 chemical is found to have better the durability against acid attack.

3. It is recommended to use chemical admixtures to achieve good quality concrete.

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References

[1] Akshara O. S., Divya Sasi, "An Experimental Study on Mechanical Proper-ties of Self Curing Concrete", International Journal of Scientific & Engineering Research, Vol. 7, Issue 10, ISSN 2229-5518, 2016, pp. 1-4.J. U. Duncombe, "Infrared navigation—Part I: An assessment of feasibility (Periodical style)," *IJREAM Trans. Electron Devices*, vol. ED-11, pp. 34–39, Jan. 1959.

[2] Dadaji B. Jadhav, Ranjana Ghate, "A Study On Self-Curing And Self-Compacting Concrete Using Polyethylene Glycol", International Research Journal of Engineering and Technology (IRJET), Vol. 4, Issue 2, ISSN 2395 -0056, 2017, pp. 1014-1019.

[3] K. S. Johnsirani, Dr. A. Jagannathan, R. Dinesh Kumar, "Experimental Investigation on Self Compacting Concrete using Quarry Dust", International Journal of Scientific and Research Publications, Vol. 3, Issue 6, ISSN 2250-3153, 2013, pp. 1-5.

[4] M. Poovizhiselvi, D. Karthik, "Experimental Investigation of Self Curing Concrete", International Research Journal of Engineering and Technology (IRJET), Vol. 4, Issue 1, ISSN 2395 -0056, 2017, pp. 298-301.

[5] Mohammad Suhail, "An Experimental Investigation on Self-Cured Concrete: A Review", International Journal of Research In Technology And Management (IJRTM), Vol. 3, Issue 1, ISSN 2454-6240, 2017, pp. 4-6.

 DOI : 10.18231/2454-9150.2018.1314

[6] Remya K M, Shilpa.V S, Dhanusha. M, Ashna L Sukumar , Ashna Ismayil, Sreerag K., "Experimental Study on Strength Characteristics of Self Curing Concrete using Poly Ethylene Glycol and Light Weight Aggregate", International Journal of Research in Advent Technology, Special Issue, International Conference on Technological Advancements in Structures and Construction, TASC- 15,Vol. 10, Issue 11, ISSN 2321-9637, 2015, pp. 73-77.

[7] S. Azhagarsamy, S. Sundararaman, "A Study on Strength and Durability of Self Curing Concrete Using Polyethylene Glycol-400", International Journal of Emerging Technology and Advanced Engineering, Vol. 6, Issue 1, ISSN 2250-2459, 2016, pp. 215-218.

[8] Sachin Julian Francis, B. Karthik, H. Gokulram, "Flexural Behavior of Self-curing Concrete with Lightweight Aggregate and Polyethylene Glycol", International Journal of Engineering Trends and Technology (IJETT), Vol. 47, Issue 2, 2017, pp. 71-77.

[9] Sanjay Raj A , Yogananda N., "Experimental Investigation on Self-Curing Self-Compacting Concrete by Replacing Natural Sand by M-sand and Coarse aggregates By Light Weight Aggregate for M-40 Grade Concrete", International Journal of Scientific and Research Publications, Vol. 4, Issue 8, ISSN 2250-3153, 2014, pp. 1-5.

[10] Sathanandham, Gobinath, "Preliminary Studies of Self Curing Concrete With the Addition Of Polyethylene Glycol" International Journal Of Engineering Research & Technology (IJERT) Vol. 2 Issue 11, 2013.

[11] Shikha Tyagi, "An Experimental Investigation of Self Curing Concrete Incorporated with Polyethylene Glycol as Self Curing Agent", International Research Journal of Engineering and Technology (IRJET), Vol. 2, Issue 6, ISSN: 2395 -0056, 2015, pp. 129-132.

[12] Shreyash Shah, Ashutosh Patil, "An Experimental Investigation of Effect of Variation of Curing Time on Compressive Strength of Concrete", International Journal of Emerging Technology and Advanced Engineering, Vol. 5, Issue 3, ISSN 2250-2459, 2015, pp. 151-154.

[13] Siddharth Jain, "Investigation of Strength Characteristics of Concrete by Replacing Curing Water with Self Curing Compounds", International Journal of Engineering Technology, Management and Applied Sciences, Vol. 5, Issue 7, ISSN 2349-4476, 2017, pp. 331-338.

[14] Snehal Bhosale, V. S. Shingade, S. K. Patil, "Experimental Characterization of Strength of Self Curing Concrete", IJARIIE, Vol. 2, Issue 4, -ISSN 2395-4396, 2016, pp. 151-160.

[15] Vishnu T, Beena B. R., "An Experimental Investigation of Self-Curing Concrete Incorporated with Light Weight Fine Aggregate and Polyethylene Glycol", IJIRST International Journal for Innovative Research in Science & Technology, Vol. 3, Issue 04, ISSN 2349-6010, 2016, pp. 116-112.

 DOI : 10.18231/2454-9150.2018.1314