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Enhancing Cement Hydration and Concrete Properties: A Study on Self-Curing Concrete with Polyethylene Glycol PEG 400

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Abstract: ***A self-curing concrete is provided to absorb water from atmosphere to achieve better hydration of cement in concrete which solves the problem of lowered cement hydration because of improper curing, and thus unsatisfactory properties of concrete. The present investigation involves the use of self-curing agent viz., polyethylene glycol (PEG) of molecular weights (PEG 400) for dosages ranging between 1% 2% & 3% by weight of cement added to mixing water.Comparative studies were carried out for water retentively, compressive strength after 28 days for conventional cured and self-cured concrete.The properties of self-cured concrete are at least comparable to and sometime better than those of concrete with traditional curing.***.

Keywords: Compression strength test, Conventional concrete**,** Polyethylene glycol, Self-curing concrete

1. Introduction

The process of controlling the rate and extent of moisture transport from concrete during Cement hydration is called curing. It may be either after it has been placed in position (or during the manufacture of concrete products), thereby providing time for the hydration of the cement to occur. Since the hydration of cement does take time in days, and even weeks rather than hours curing must be undertaken for a reasonable period of time, if the concrete is to achieve its potential strength and durability. Curing may also encompass the control of temperature since this affects the rate at which cement hydrates. The curing period may depend on the properties required of the concrete, the purpose for which it is to be used, and the ambient conditions, i.e. the temperature and relative humidity of the surrounding atmosphere. Curing is designed primarily to keep the concrete moist, by preventing the loss of moisture from the concrete during the period in which it is gaining strength.

2. Self curing concrete

The concept of self-curing agents is to reduce the water evaporation from concrete, and hence increase the water retention capacity of the concrete compared to conventional concrete. It was found that water soluble polymers can be used as self-curing agents in concrete. This investigation discusses different aspects of achieving optimum cure of concrete without the need for applying external curing methods. The effect of curing, particularly new techniques such as "self-curing", on the properties of high performance concrete is of primary importance to the modern concrete industry.Following list of some chemicals which are hydrophilic in nature.

- Polyvalent alcohol
- Polyethylene glycol (peg)
- Poly-acrylic acid
- Xylitol, sorbitol
- Glycerin
- Phytosterols
- Hyaluronic acid
- Polyxyelhylene (poe)
- Sodium pyrrolidone carboxylate (pca-na),
- Stearyl alcohol
- Cetyl alcohol
- Thermosetting polymers
- Urethane

3. Material study

Grade of concrete used – M20

Figure 1: Cement, Fine aggregate and Coarse Aggregate

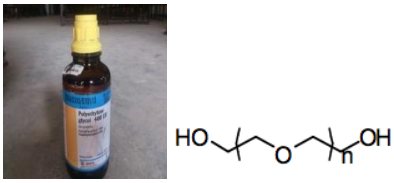


Figure 2: Polyethylene Glycol (PEG -400) and Chemical structure of PEG

4. Mix Proportions

S.NO	Cement OPC (Kgs)	Fine Aggregate (Kgs)	Coarse Aggregate (Kgs)	Water (Lts)
1	17.65	29.6	37.6	6.3
2	17.65	29.6	37.6	6.3
3	17.65	29.6	37.6	6.3

a) Conventional Concrete

Figure 3: Conventional Concrete

b) Self-Curing Concrete

Figure 4: Self curing Concrete

S.No	PEG with different ratios	Cement OPC (Kgs)	Fine Aggregate (Kgs)	Coarse Aggregate (Kgs)	Water (Lts)	PEG-400 (mgs)
1	PEG-1%	17.65	29.6	37.6	6.3	365
2	PEG-2%	17.65	29.6	37.6	6.3	740
3	PEG-3%	17.65	29.6	37.6	6.3	1100

5. Testing

Compression strength test is done for both the specimen (conventional and self curing concrete)

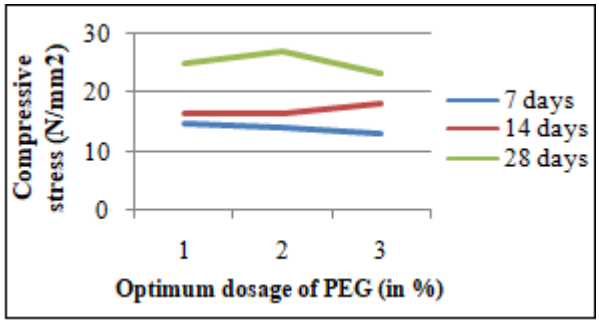
Figure 5: Compression Testing Machine setup

Comparison of PEG- 1%, 2%, 3%

- The compressive strength was found to increase in self curing concrete comparing to conventional concrete.
- The result of compressive strength for different dosage of PEG-400 is represented in the below table 10.
- Thus, with these values the opium gain strength in PEG-400 is obtained by plotting the graph.

This optimum dosage in PEG-400 is compared with the conventional concrete and the increase in strength is determined.

No. of days	PEG 1%	PEG 2%	PEG 3%
7 days	14.8	14	13.16
14 days	16.6	16.6	18
28 days	25.16	27.16	23.33



Inference:

- In this analysis, the addition of admixture i.e. PEG 1% to the concrete, gives the gain strength in concrete comparing to the conventional concrete.
- Where in addition to the admixture i.e. PEG 2% to the concrete, there will be increase in of strength in the concrete comparing to the conventional concrete.
- Further addition of admixture i.e. PEG 3% to the concrete, there will be loss in compression strength comparing to PEG 1% and 2%.
- Thus, from the above discussions it is concluded that the admixture added to the concrete i.e. PEG 2% gives the optimum increase in the compression strength than the other dosage of PEG 1%, 3% comparing with the conventional concert.

6. Conclusion

- Concrete containing Ordinary Portland Cement with lower molecular weight PEG 1% dosage (by weight of cement) has maximum weight gain compared to the 2% and 3%.
- Concrete containing Ordinary Portland Cement with lower molecular weight PEG 2 % dosage (by weight of cement) has minimum weight loss compared to the 1% and conventional concrete.
- Concrete containing Ordinary Portland Cement with lower molecular weight PEG 3% dosage (by weight of cement) has minimum weight loss compared to the 1% and 2% and conventional concrete.
- In this investigation, it is clearly noticed that concrete containing Ordinary Portland Cement with lower molecular weight PEG-1% (by weight of cement) gives better results when compared to the conventional concrete.
- As percentage of PEG-400 slump is increased for M20 grade concrete.Strength of self-curing concrete is on par with conventional concrete.
- Self-curing concrete is the answer to many problems faced due to lack of proper curing

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