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Effect of Polyethylene Glycol as Internal Curing Agent in Concrete

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ABSTRACT: Proper curing of concrete structures is important to ensure that they meet their intended performance and durability requirements. Therefore an effective in situ curing is necessary to maximize the degree of hydration and to minimize the cracking problems due to drying shrinkage. Traditional external curing could not achieve a desired effect due to the very low permeability of high-performance concrete, so some researchers shifted their attention to internal curing, a new curing method that may greatly enhance the curing effect on high-performance concrete. The present study involves use of shrinkage reducing admixture like Polyethylene Glycol (PEG-600) as internal curing compound. This polyethylene glycol 600 on varying percentages as 0.5, 1, and 1.5 is used in M30 concrete. This helps in self curing, better hydration, and hence good compressive strength. They trap the moisture within the structure and prevent it from evaporation which normally occurs due to the hydration process.

KEYWORDS: Polyethylene Glycol, Internal curing, Polymers

I. INTRODUCTION

Concrete is most widely used construction material due to its good compressive strength & durability. The properties of hardened concrete (durability) are greatly influenced by curing since it has a remarkable effect on hydration of cement. Any laxity in curing will badly affect the strength & durability of concrete. Special curing concrete is the one of the special concrete in mitigating insufficient curing due to human negligence. Internal Curing of concrete using small well distributed water reservoirs seems to be able to solve this problem. In this study, the effect of shrinkage reducing admixture (Polyethylene Glycol) as an agent for internal curing on mechanical strengths of concrete with low w/c is investigated.

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.” Conventionally, curing concrete means creating conditions such that water is not lost from the surface i.e., curing is taken to happen ‘from the outside to inside’. In contrast, ‘internal curing’ is allowing for curing ‘from the inside to outside’ through the internal reservoirs (in the form of saturated lightweight fine aggregates, super absorbent polymers, or saturated wood fibres) Created. ‘Internal curing’ is often also referred as ‘Self–curing.’

PietroLura (2007) investigated to reach a better comprehension of autogenous shrinkage in order to be able to model it and possibly reduce it. Once the important role of self-desiccation shrinkage in autogenous shrinkage is shown, the benefits of avoiding self-desiccation through internal curing become apparent.

A.S. El-Dieb (2012) investigated the effect of using water-soluble polymers (polyethylene glycol (PEG) and poly acrylamide (PAM)) as self-curing agents on the water retention, degree of hydration, water absorption, permeable pores and micro structural characteristics of Portland cement mixes with and without silica fume as cement replacement. Investigation of the micro structural characteristics showed a denser microstructure and a lower tendency for micro crack formation for self-cured mixes with and without silica fume compared with similar non-cured mixes.

Dr.T Suresh Babu and Srinivas kumar (2015) studied the effect of admixture (PEG-200) on compressive strength, split tensile strength at one percentage for M25 mix and compared it with the properties of PEA (Poly Ethylene Alcohol). It was found that Poly Ethylene Glycol-200 is a good self curing agent when compared with Poly Ethylene Alcohol. The present Study was shown about a clear cooperate picture about the strengths of PEG-200 and PEA and its stress strain behaviour also shown clearly. This study gives a clear notation on Durability aspect also.

Polyethylene glycols (PEGs) are family of water soluble linear polymers formed by the additional reaction of Ethylene oxide (EO) with Mono ethylene glycol (MEG) or Diethylene glycol. For this experimental study PEG 600 was used. PEG 600 consists of a distribution of polymers of varying molecular weights with an average of 600. One common feature of PEG appears to be the water-soluble nature.

II. EXPERIMENTAL PROGRAM

Concrete mixes are made using a planetary mixer according to the following mixing procedure: first the dry components (binder, fine and coarse aggregates, SAP) are mixed for 1 min, and afterwards the water and super plasticizer are added and mixing continues for another 4 min. An intensive experimental program is performed to study the effect of internal curing on different types of concrete properties (compressive strength, flexural strength, splitting tensile strength and elastic modulus).

Mix Proportion

Cement	= 394 Kg/m^3
Fine aggregate	= 743.08 Kg/m^3
Coarse aggregate	= 1090 Kg/m^3
Water	= 197 l/m^3
Proportion	= 1 : 1.89 : 2.76

Fig. 1. Experimental Setup

III. RESULTS AND DISCUSSION

The test results show that a very small increase in compressive strengths and spilt tensile strengths were observed with the addition of PEG in different percentages. Though the increase in strengths were very small, it was observed that PEG involves complete internal curing of the concrete and helps to achieve a strength very nearer to the full strength of conventional reference mix.

Compressive Strength: The results of the compressive strength are represented in Table 1 and the graphical representation is shown in Fig 1. In the case of M30 compressive strength increased up to 0.5% and then decreased.

Split Tensile Strength: The results of the Split tensile strength are represented in Table 2 and the graphical representation is shown in Fig 2. In the case of M30 split tensile strength increased up to 0.5% and then decreased.

Table1. Compressive Strength Results

% of PEG 600	Compressive Strength	
	7 DAYS (N/mm^2)	28 DAYS (N/mm^2)
0	25.6	38.7
0.5	26.3	39.5
1	26	39.3
1.5	25.96	38.9

Fig. 1 Comparison of Compressive Strength

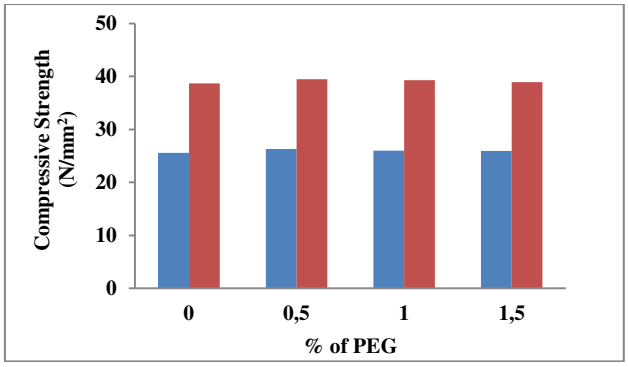
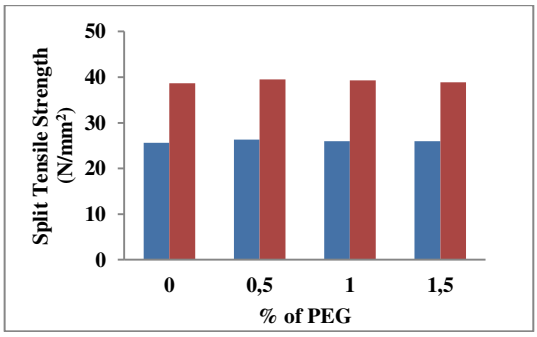


Table2. Split Tensile Strength Results

% of PEG 600	Split Tensile Strength	
	7 DAYS	28 DAYS
0	2.12	3.81
0.5	2.56	3.96
1	2.23	3.96
1.5	2.17	3.87

Fig. 2 Comparison of Split Tensile Strength



IV. CONCLUSION

The main conclusions of this study are listed below:

- Addition of PEG leads to increase of mechanical strength (Compressive and Split tensile).
- A higher and earlier heat production rate due to hydration is found for higher amounts of PEG added to the reference concrete.
- The effectiveness of internal curing by means of PEG applied to concrete is the highest if 0.5% of PEG is added.

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