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RESEARCH ARTICLE

EXPERIMENTAL INVESTIGATION ON STRENGTH PROPERTIES OF SELF CURING CONCRETE USING POLYETHYLENE GLYCOL-600

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ABSTRACT

The strength and durability of concrete depends on the curing of concrete. The use of shrinkage reduces admixtures such as polyethylene glycol, poly vinyl alcohol etc., influence on the hydration property and the strength of concrete. Any negligence in curing will interfere in the strength and durability of concrete. Self-curing concrete (SCC) is gaining importance in recent days as it avoids errors which were caused by human, structures which are not accessible, terrains where curing becomes difficult and in places where the fluoride content badly influences the property of concrete. This kind of curing technique can widely be practiced in places where there is scarcity of water. In this research paper M20 grade of concrete was chosen and the shrinkage reducing admixture polyethylene glycol (PEG-600) was varied in different proportions to concrete. Polyethylene glycol is non-toxic, odorless, neutral, lubricating, non-volatile and non-irritating and is used in a variety of pharmaceuticals. Cubes and cylinder were casted with varying percentage of PEG-600 of 0.5%, 1%, 1.5% and 2%. The compressive strength at 3 days, 7daysand 28 days have been obtained with normal curing and self curing condition. It was found that a compressive strength of 37.77MPa and split tensile strength 12.88MPa for 1% of PEG-600 was obtained at the end of 28 days. These results are very much comparable to the compressive strength and split tensile strength of conventional concrete. Hence SCC shows a proves to be a better options in places were scarcity of water.

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INTRODUCTION

Curing of concrete place an important role in the enhanced durability of structures (Selvamony *et al*., 2010). In places where there is scarcity of water prolonged curing is highly not practicable. For every $1m^3$ of concrete construction about $3m^3$ of water is required of which most of water is used for curing (Prema *et al*., 2014). With the growing infrastructure development the conventional curing method proves to be very costly due to less resource of water. SCC is almost the same as the vibrated concrete to which chemical and mineral admixtures are added to it with different proportions (Vivek *et al*., 2015). By the use of viscosity enhancing agents or by decreasing the w/c ratio the viscosity of cement can be improved (Ozawa *et al* 1995, Khayat 1999). Use of self curing admixtures is gaining importance nowadays to minimize the use of water. The use of chemical admixtures reduces the shrinkage and permeability in concrete. There is also enhanced effect on the compressive strength of concrete by using chemical admixtures while producing self curing concrete (Selvamony *et al*., 2010). Self curing concrete can be widely used in inaccessible areas and vertical structures (AkankshaAnantraoPatil, 2014). Self curing concrete is the best solution to the problems faced in the desert region and faced due to lack of proper curing. Curing can be performed in a number of ways to ensure that an adequate amount of water is available for cement hydration to occur. Curing of concrete without external curing method is not possible at all times (Ankith, 2015). In order to prevent evaporation at the surface of concrete an oil polymer need to be applied to effectively seal the surface (Kavithaa *et al*., 2015). In order to effectively implement SCC under field conditions it should be locally available (Tikalsky *et al*., 2006). Poly ethylene glycols (PEGs)

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are family of water-soluble linear polymers formed by the additional reaction of ethylene oxide (EO) with mono ethylene glycols (MEG) or diethylene glycol. The generalized formula for polyethylene glycol is: H(OCH2 CH2) n OH where n is the average number of repeating oxyethylene groups typically from 4 to about 180.PEG is widely used in pharmaceutical formulations, cosmetics, household products, ceramic and tiles, adhesives and textile and other applications such as paint and coatings.

MATERIALS

The Ordinary Portland cement of 43-grade PPC was used in this study conforming to IS: 12269-1987. The river sand is used as fine aggregate conforming to the requirements of IS: 383-1970. Coarse aggregate obtained from local quarry units has been used for this study, conforming to IS: 383-1970 is used. The aggregates were tested as per IS 2386-1963.The water used for experiments was potable water conforming as per IS: 456-2000. Polyethylene Glycol-600(PEG-600) the polymers added in the mix mainly form hydrogen bonds with water molecules and reduce the chemical potential of the molecules of water which in turn reduces the vapour pressure, thus reducing the rate of evaporation from the surface. The physical and chemical property of PEG-600 is shown in Table 1.

Table 1. Physical and chemical properties – polyethylene glycol

Appearance	Clear liquid or white solid
Odour	Mild odour
Solubility	Soluble in water
Density range	1.1 to 1.2 (increases as molecular weight increases)

METHODOLOGY

The collection of material for the self curing concrete such as PEG 600are obtained and for M20 concrete mixes were collected and casted. M20 Grade mixes were designated in accordance with IS: 10262-2009. Conventional concrete was casted with M20 mix and made to water curing. Another set of cubes were casted using PEG-600 of 0.5%, 1%, 1.5% and 2% with M20 concrete and allowed for atmosphere curing. Similarly cubes were casted for 3, 7and 28 days for conventional and PEG 600 to study the strength properties (compressive strength and split tensile strength). For this experimental study a total of 45 cubes and 45 cylinder were casted for determine the strength properties.

RESULTS AND DISCUSSION

The compressive and split tensile strength of M20 grade concrete mix for different percentage PEG-600 as shown in Table II and Table III. The results for various percentages are discussed below.

- For M20 concrete the compressive strength at the end of 3, 7 and 28days for 0.5% of additional of PEF-600 the compressive strength showed an increasing value of 22.22, 27.55 and 35.55N/mm^{2}as shown in Fig.1.
- A similar trend of increasing value was observed when the PEG-600 is increased to 1% and 1.5% the maximum value obtained at the end of 28days for 1% and 1.5% was 37.77 and 34.33N/mm^2 at the end of 28days as shown in Table II.
- A gradually increase of 0.5% of PEG 600 (2%) showed a decreasing trend in the compressive strength at the end of 3, 7 and 28 days. The compressive strength observed at the end of 28days for 2% of PEG 600 is 31.55N/mm^2.
- Split tensile strength at the end of 3, 7 and 28days for 0.5% of additional of PEF-600 the Split tensile strength showed an increasing value of 8.44, 8.90 and 10.22N/mm^2 as shown in Fig.2.
- A similar trend of increasing value was observed when the PEG-600 is increased to 1% and 1.5% the maximum value obtained at the end of 28days for 1% and 1.5% was 12.88 and 9.33N/mm^2 at the end of 28days.
- A gradually increase of 0.5% of PEG 600 (2%) showed a decreasing trend in the Split tensile strength at the end of 3, 7 and 28 days. The Split tensile strength observed at the end of 28days for 2% of PEG 600 is 9.55N/mm^2 as shown in Table III.

Table 2. Cube Compressive strength of cubes with varying % of PEG 600

% of PEG 600	Compressive strength (N/mm2)		
	3 days	7 days	28 days
0	9.33	15.11	28.44
0.5	22.22	27.55	35.55
1	28.44	29.33	37.77
1.5	23.11	28.1	34.22
2	22.1	26.22	31.55

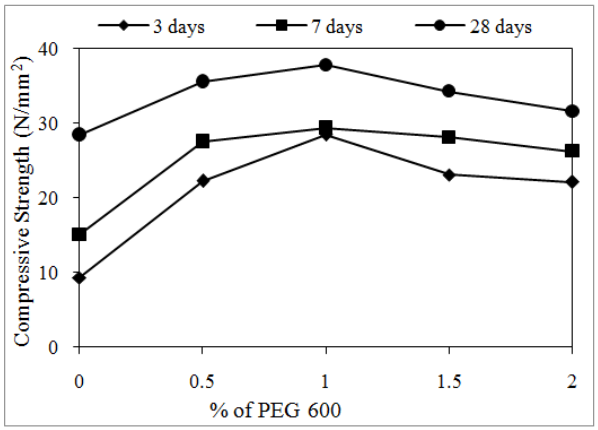

Fig.1. Compressive Strength of Cubes with varying % of PEG 600

Table 3. Split Tensile Strength of Cylinder with varying % of PEG600

% of PEG 600	Split Tensile strength (N/mm2)		
	3 days	7 days	28 days
0	6.6	8.8	10.66
0.5	8.44	8.9	10.22
1	7.55	10.22	12.88
1.5	7.33	8.44	9.33
2	6.9	7.77	9.55

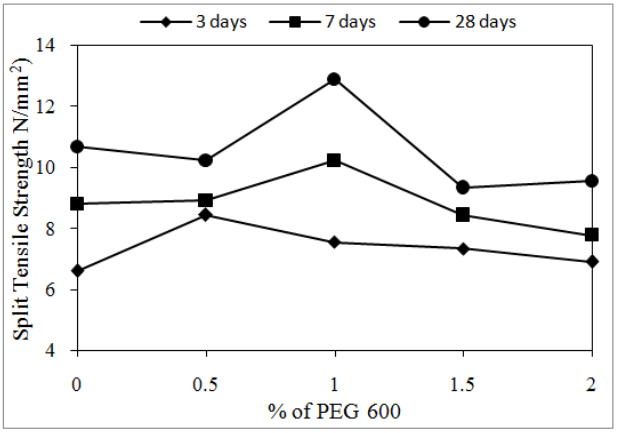

Fig.2. Split Tensile Strength of Cylinder with varying % of PEG600

Conclusion

A maximum Compressive strength was found for 1.0% of PEG-600 in M20 grade of concrete. Hence self curing concrete showed a better performance with respect to its compressive and split tensile properties. Thus Self-cured concrete is thus found to be less porous compared to the conventional types. It shows that the self curing concrete is able to withstand extreme conditions and corrosion effects. Viewing the above strength characteristics properties it can be concluded that self curing concrete is a better option in field conditions where there is scarcity of water.

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