STUDY ON MECHANICAL PROPERTIES OF SELF CURING CONCRETE USING PEG 600

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ABSTRACT

Concrete is the material which is used worldwide in the construction. Curing of concrete play a vital role in the strength gaining of concrete. Curing of concrete is the process of providing satisfactory moisture content in concrete during its early ages in order to develop the desired properties of concrete .Conventional curing need a large amount of water, meanwhile scarcity of potable water increases day by day, hence self curing concrete concept arise. This paper aims to study the properties of self curing concrete obtained by the addition of self curing agent polyethylene glycol-600. In this experimental investigation the strength characteristics of concrete that is compressive strength, split tensile strength and flexural strength has been studied and compared with conventionally cured concrete. IS method of mix design was adopted. From the results optimum percentage of PEG addition was obtained.

Keyword: - *self curing concrete, PEG600, concrete, compressive strength, flexural strength, split tensile strength, admixtures.*

1. INTRODUCTION

Concrete is the widely used construction material due to its ability to cast into required shape and size. The most important aspect in usage of concrete is the development of desired strength which mainly depends on hydration of cement mortar. Curing allows continuous hydration of cement and consequently continuous gain in the strength. Curing of concrete can be done in several methods, among them external and internal curing has gained popularity so far. Self-curing or internal curing is a technique that can be employed to provide additional moisture in concrete for more effective hydration of cement and reduced self-desiccation. According to the ACI 308 committee, ‘‘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’’. It was found that water soluble polymers can be used as self-curing agents in concrete. Concrete incorporating self-curing agents will represent a new trend in concrete construction in the new millennium. Results proved that the concrete with polyethylene-glycol as self-curing agent, attained higher values of mechanical properties than with other type of curing agents.

1.1 Principal and Mechanism of Self Curing

An exposed surface suffers from continuous evaporation of moisture due to the difference in chemical potentials between the vapour and liquid phases. Also when the mineral admixtures react completely in a blended cement system, their demand for curing water can be much greater than that in a conventional ordinary portland cement concrete. When this water is not readily available, significant autogenous deformation and cracking may result. Due to the chemical shrinkage occurring during cement hydration, empty pores are created within the cement paste, leading to a reduction in its internal relative humidity and also to shrinkage which may cause early-age cracking.

It is not possible to provide curing by external supply of water from top surface at the rate required to satisfy the

ongoing chemical shrinkage. The polymers added in the mix mainly form hydrogen bonds with water molecules and reduce the chemical potential of the molecules which in turn reduces the vapour pressure [5]. The usage of polyethylene-glycol reduces the evaporation of water from the surface of the concrete and thereby providing water retention PEO) or polyoxyethylene (POE), depending on its molecular weight. It is a condensation polymer of ethylene oxide and water. The structure of PEG is commonly expressed as $H(OCH_2CH_2)nOH$, where n is the average number of repeating oxyethylene groups typically from 4 to about 180. Polyethylene glycols are available in average molecular weight ranging from 200 to 8000.The low molecular weight compounds up to 700 are colourless, odorless and viscous compounds with a freezing point from -10^{o}C (di-ehylene glycol),while polymerized compounds with high molecular weight more than 1000 are wax like solids with melting point up to 67^{o}C. One common feature of PEG appears to be the water-soluble nature. Polyethylene glycol is non-toxic, odourless, neutral, lubricating, non-volatile and nonirritatingand is used in a variety of pharmaceuticals

2. MATERIALS

CEMENT: The Ordinary Portland Cement of 53 grade conforming to IS: 12269-2013 was used. Initial setting time, standard consistency, specific gravity test and fineness modulus test were performed to find the properties of cement.

COARSE AGGREGATE: 20 mm coarse aggregate, conforming to IS: 383 -1970 was used. The properties of coarse aggregates such as specific gravity and water absorption were obtained.

FINE AGGREGATE: The fine aggregate used in the study was manufactured sand. It was screened to eliminate over size particles. As per IS:383-1970, the fine aggregate conforming to zone II was used.

WATER: Potable water was used in the experimental work for mixing. The strength of cement concrete comes mainly from the binding action of the hydrated cement gel. The requirement of water should be reduced to that required for chemical reaction of unhydrated cement as the excess water would end up in only formation of undesirable voids in the hardened cement paste in concrete.

POLYETHYLENE GLYCOL (PEG)-600: For the experimental programme PEG 600 was used. PEG 600 consists of a distribution of polymers of varying molecular weights with an average of 600.The appearance of PEG 600 is clear liquid. One common feature of PEG appears to be the water-soluble nature

Table -1: Material properties

Materials	Properties	Values
Cement	Specific gravity Standard consistency Initial setting time Fineness modulus	3.125 30% 120min5%
Coarse Aggregate	Specific gravity Water absorption	2.74 0.8%
Fine Aggregate	Specific gravity Fineness modulus	2.605 2.8
PEG-600	Specific gravity	1.13

3. CASTING

Specimens were cast for various test with following dimensions.

1. Cubes of size 150mm X 150mm X 150mm
2. Cylinder of size 150mm **ϕ** X 300mm length
3. Beams of size 100mm X 100mm X 500mm

4.MIX PROPORTION OF MATERIALS

Table -2: Mix proportion

Cement	**426 kg/m^3**
Water	**191 kg/m^3**
Fine aggregate	**640 kg/m^3**
Coarse aggregate	**1127 kg/m^3**
Water cement ratio	**0.42 g/m^3**

5. EXPERIMENTAL RESULTS

A. Compressive strength

Table 1: Compressive strength values in different percentage of PEG-600

SL NO	% OF PEG	Compressive strength (N/mm^2)
1	0	32.88
2	0.5	34.92
3	1	35.51
4	1.5	38.11
5	2	36.37

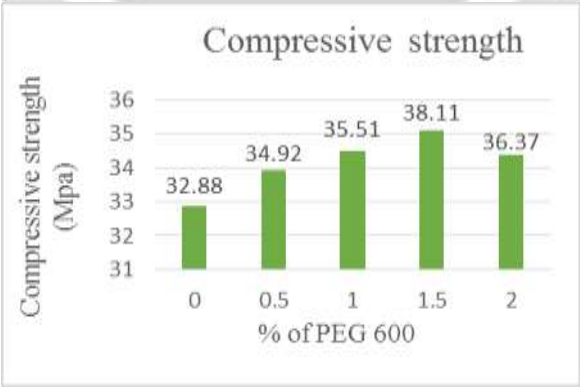

Fig 1: Variation in Compressive strength of the concrete

B. Split tensile strength

Table 2: Split tensile strength values in different percentage of PEG-600

SL NO	% OF PEG	Split tensile strength (N/mm^2)
1	0	3.11
2	0.5	3.30
3	1	3.44
4	1.5	3.8
5	2	3.39

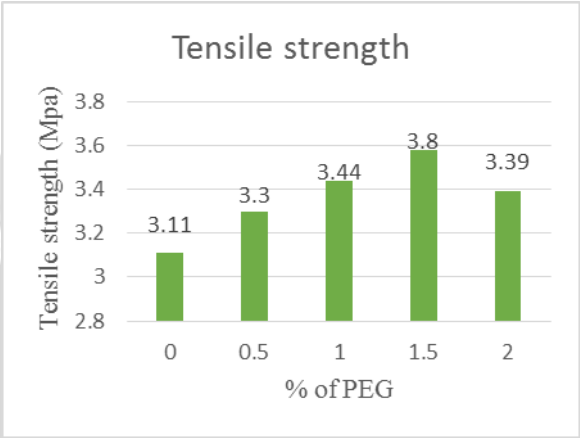

Fig 2: Variation in Split tensile strength of the concrete

C. Flexural strength

Table 3: Flexural strength values in different percentage of PEG-600

SL NO	% OF PEG	Flexural strength (N/mm^2)
1	0	4.24
2	0.5	4.58
3	1	5.90
4	1.5	6.20
5	2	5.78

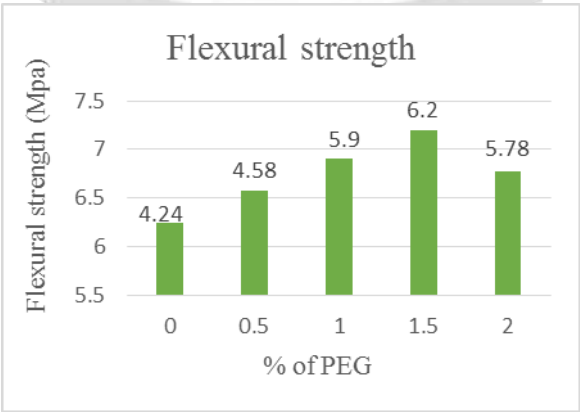

Fig 3: Variation in Flexural strength of the concrete

6. CONCLUSIONS

Concrete, which is a major component of construction industry needs to attain desired strength by 28 days. The deficiencies in conventional curing can be avoided by introducing the concept of self-curing. Self-cured concrete shows improvement in mechanical properties of concrete and ensure sustainable development. Addition of self curing agent Poly ethylene glycol (PEG-600) increases the mechanical properties of concrete. The following conclusions may be drawn from the experimental work conducted on self-curing concrete of grade M30 after 28 day of curing.

- The obtained value of compressive strength of self- cured concrete is more when compared to conventionally cured concrete. An optimum dosage of PEG-600 for maximum compressive strength was found to be 1.5% for M30 grade concrete.
- The percentage increase in compressive strength was found to be 10% compared to conventionally cured concrete.
- The obtained split tensile strength, flexural strength and modulus of elasticity of self-cured concrete showed a maximum split tensile strength at 1.5% for the M30 grade concrete

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