An experimental study on Strength and durability properties of Self Curing Concrete

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I. INTRODUCTION

Proper curing of concrete structures is important to ensure that they meet their intended performance and durability requirements. Conventional curing procedures of water ponding, as used for drying shrinkage are not effective in the case of autogenous shrinkage. They may eliminate the autogenous shrinkage in small cross sections only because the penetration of water from the external surface is limited. the different strategies have been developed in recent years, based on the Use of internal water reservoirs; one strategy which has been investigated more extensively is based on the use Of light weight aggregates, while the other is based on the use of water absorbing polymers. Both water Saturated porous aggregates and water saturated polymers are able to act as internal reservoirs. 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. The additional internal water is typically supplied by using relatively small amounts polyethylene glycol in the concrete. Benefits of internal curing include increased hydration and strength development, reduced autogenous shrinkage and cracking, reduced permeability and increased durability.Internal curing (IC) is a very promising technique which is adopted to maintain moisture and temperature conditions in a freshly placed cementations mixture to allow hydraulic cement hydration and pozzolanic reactions to occur so that the potential properties of the mixture may develop. The concept of internal curing has been developed and now been in practice to eliminate some problems occurred in case of traditional curing. Internal curing is defined as "supplying water throughout a freshly placed cementations mixture using reservoirs, poly-ethylene glycol that readily release water as needed for hydration or to replace moisture lost through evaporation or self-desiccation." From this definition two major objectives of internal curing can be identified as maximizing hydration and minimizing self-desiccation along with its accompanying stresses which may cause early-age.

II. OBJECTIVES

To study the effect of polyethylene glycol (PEG 600) on strength and durability characteristics of Self-curing concrete. The mechanical properties of concrete such as compressive strength, split tensile strength and the durability properties of concrete can be obtained by conducting Acid resistance, alkalinity measurement by using the varies percentage of PEG from 0% to 1% by weight of cement for M20 grade of concrete. To determine the Water retention capacity for the concrete mixes incorporating self-curing agent is to be compared with conventional concrete.

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Admixture Used

The extract from Polyethylene glycol 600 at 0 %- 10 % by weight of cement. Polyethylene glycol (600) is a low-molecular-weight grade of polyethylene glycol. It is a clear, colourless, viscous liquid. Due in part to its low toxicity, PEG

600 is widely used in a variety of pharmaceutical formulations.

Polyethylene glycol 600 Properties

Chemical formula- $C_{2n}H_{4n+2}O_{n+1}$

Molar mass- 570 - 630

Density-1.13 g/cm³ (20 °C)

Melting point-22°C (71.6°F).

Viscosity-50-190 mPa.s (20 °C)

Flash point-238 °C

III. TYPES OF TESTS

Strength test

- Compressive Strength Test
- Tensile Strength Test

Durability test

- Acid resistance

IV. CONCRETE MIXES FORMULATIONS

Concrete Mixes Formulations

S.NO	% OF PEG	CUBE	CYLINDER
1	0.2%	6	6
2	0.4%	6	6
3	0.6%	6	6
4	0.8%	6	6
5	1%	6	6

V. RESULTS AND DISCUSSION

General

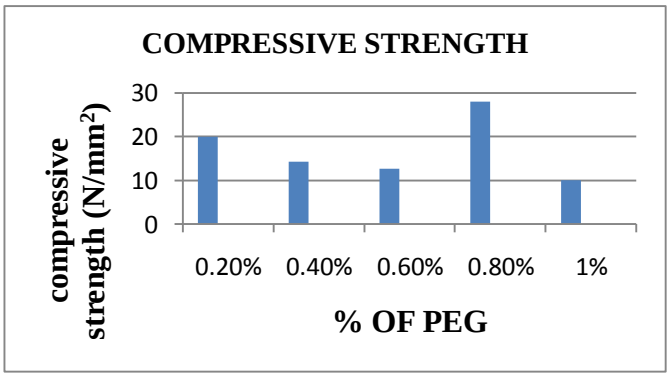
The mixing, compacting and curing of concrete are done according to IS 516: 1959. The plain samples of cubes, and cylinders were cured for 28 days in water pond and the specimens with PEG600 were cured for 28 days at room temperature by placing them in shade. The specimens were taken for testing such as compression test, split tensile strength test. The specimens were tested in the universal testing machine. Three numbers of specimens in each were tested and the average value is calculated. The results were compared and analysed with that of control mix.

Compressive Strength Test Results

Results of cubeCompressive Strength

Concrete Grade: M20 Mix ratio: 1:1.5:3 PEG (600): 0 -1%

S.NO	% OF PEG	AVG STRENGTH (N/mm2)
1	0.2%	20
2	0.4%	14.22
3	0.6%	12.67
4	0.8%	28
5	1%	20



Compressive Strength Graph

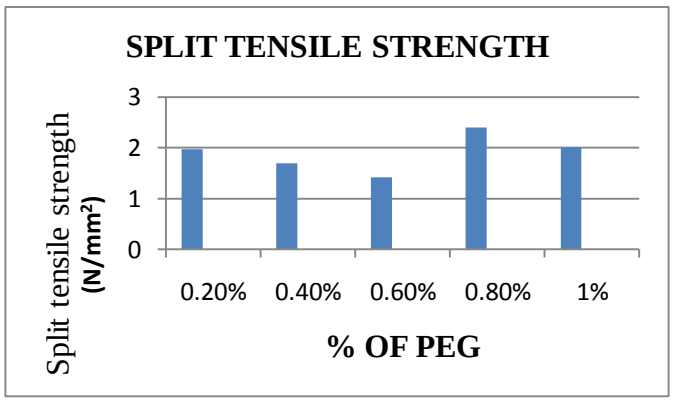
The results of the compressive strength are represented in Table 9.1 and the graphical representation is shown in Fig 9.1. The compressive strength was found to increase up to 0.4% PEG600 for M20 grade of concrete.

Split Tensile Strength Test Results

Results of Split Tensile Strength EG (600): 0-1%

S.NO	% OF PEG	Average split tensile strength (N/mm2)
1	0.2%	1.97
2	0.4%	1.69
3	0.6%	1.41
4	0.8%	2.40
5	1%	2.10

Strength characteristics of self-cured concrete with 0-1% PEG (600):



Split Tensile Strength Graph

The results of the compressive strength are represented in Table 9.2 and the graphical representation is shown in Fig. The split tensile strength was found to increase up to 0.8% PEG600 for M20 grade of concrete.

VI. DURABILITY TEST

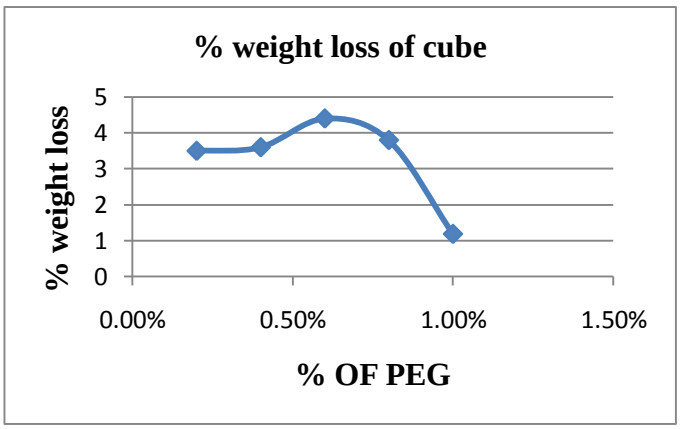
Acid Resistance (Sulphuric Acid)

Cubes of sizes 150mm were cast and cured for 28 days. After 28 days curing cubes were taken out and allowed for drying for 24 hours and weights were taken. For acid attack 5% sulphuric acid acid is used. The cubes were to be immersed in acid solution for a period of 45 days. The concentration is to be maintained throughout this period. After 45 days the specimens were taken from acid solution. The surface of specimen was cleaned and weights were measured. The specimen was tested in the compression testing machine under a uniform rate of loading 140Kg/cm2 as per IS 516. The mass loss and strength of specimen due to acid attack was determined.

Weight Loss Table of Cube

Average result of weight loss in M20 grade concrete cube

% of PEG	% weight loss
0.2%	3.5
0.4%	3.6
0.6%	4.4
0.8%	3.8
1%	1.19



Average Result of Weight Loss of Cube

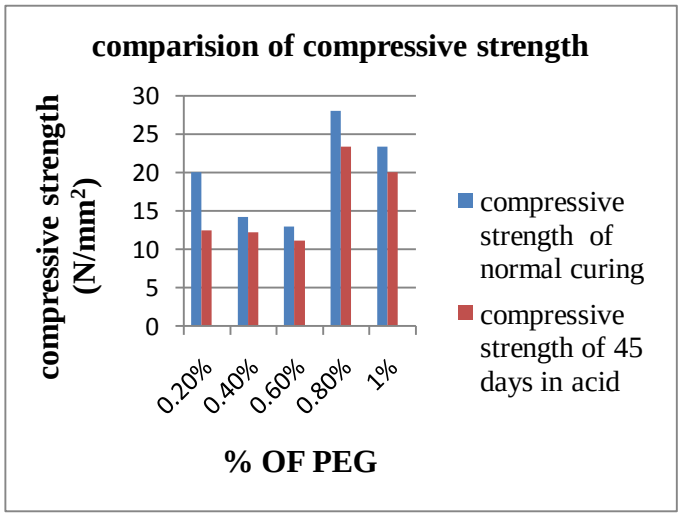
Table shows average result of weight loss of cube in acid for 45 days immersed in acid environment of weight loss 1% of polyethylene glycol.

Compressive strength comparison of acid curing

Average result of cube compressive strength in acid

% of polyethylene glycol	Average compressive strength (N/mm2)	Average compressive strength After acid curing (N/mm2)

0.2%	20	12.44
0.4%	14.22	12.22
0.6%	13	11.11
0.8%	28	23.33
1%	23.33	20



Average Result of Cube Compressive Strength In Acid

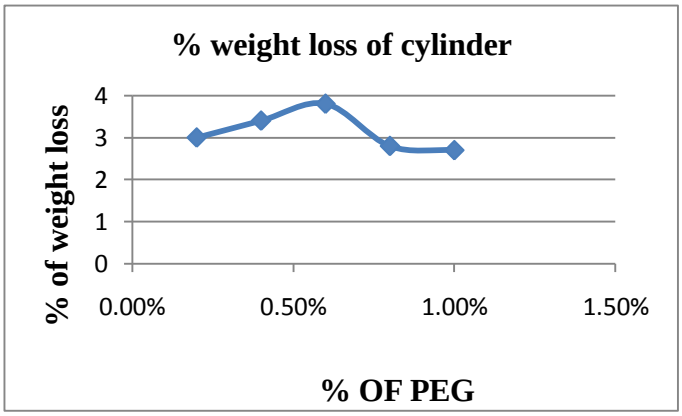
Table shows average result of compressive strength of cube in acid for 45 days. From this table 0.8% of polyethylene glycol specimen give the compressive strength compare to other specimen such as 0.2%, 0.4%, 0.6%, 0.8%, 1%.

WEIGHT LOSS AND STRENGTH TEST OF CYLINDER

Weight Loss Table of Cylinder

Table9.5 Average result of Weight loss table of cylinder

% of PEG	% weight loss
0.2%	3.0
0.4%	3.4
0.6%	3.8
0.8%	2.8
1%	2.7



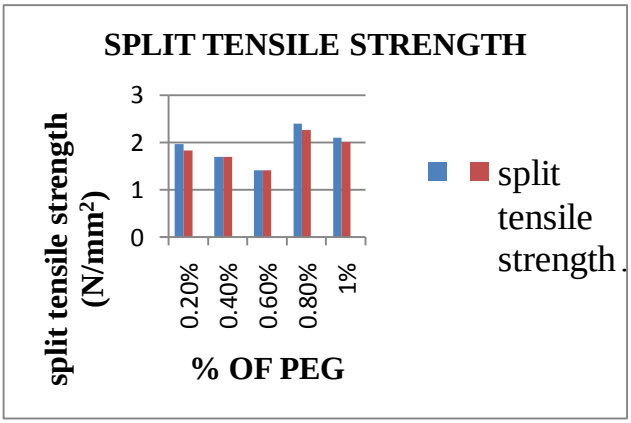
Average result of Weight loss table of cylinder

Table shows average result of weight loss table of cylinder in acid for 45 days immersed in acid environment of weight loss 1% of polyethylene glycol.

SPLIT TENSILE STRENGTH COMPARISONOF ACID CURING

Average of split tensile strength test in acid

% of polyethylene glycol	Average split tensile strength(N/mm2)	Average split tensile strengthAfter acid curing (N/mm2)
0.2%	1.97	1.83
0.4%	1.69	1.69
0.6%	1.41	1.41
0.8%	2.40	2.26
1%	2.10	2.0



Average of split tensile strength test in acid

Table shows average result of split tensile strength test in acid for 45 days. From this table 0.8% of polyethylene glycol specimen give the split tensile strength compare to other specimen such as 0.2%, 0.4%, 0.6%, 0.8%, 1%

Weight Loss and Strength Test of Cube

Weight loss and compressive test on cube

Cylinder and cube after immersed acid curing

VII. CONCLUSION

1. The rate of evaporation is reduced and the water retention capacity has been increased by increasing the percentage of PEG.
- 2. The optimum dosage of PEG600 for compressive strength was found to be 0.8% for M20 grades of concrete. As percentage of PEG600 increased slump increased for M20 grades of concrete.
- 3. Split tensile strength of self-cured concrete for dosage of 0.8% was higher than water cured concrete.
- Considering the internal curing with that of external curing, the cost of internal curing proves to be cheaper when compared with that of external curing.
- 4. Internal curing concrete is thus found to be less porous compared to the conventional types.
- Strength properties of self-curing concrete were compared with conventional concrete.

5. Durability properties of self-curing concrete were compared with conventional concrete.

6. Durability test of self-cured concrete for dosage of 0.8% was higher than water cured concrete.

7. Curing of concrete has been a major concern for the quality of work. The improper curing will result in shrinkage cracks.

8. Various research works had been carried out to bring out self-curing concrete. Based on the various studies, it is proposed to use PEG as a self-curing agent. And Self curing concrete is the answer to many problems faced due to lack of proper curing.

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