Strength Properties of Concrete using Polyethylene Glycol (PEG-600)

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Abstract— The strength and durability of concrete depends on the curing of concrete. 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, superabsorbent polymers, or saturated wood fibres) Created.

Key words: Concrete, Polyethylene Glycol (PEG-600)

I. Introduction

Curing plays a major role in the development of concrete properties during construction. Curing is frequently used to describe the process by which hydraulic cement concrete matures and develops hardened properties over time as a result of the continued hydration of the cement in the presence of sufficient water (ACI, 2008). The role of curing is to reduce water evaporation from the concrete and maintain satisfactory moisture content, especially during early ages, for continuation of the hydration process that is necessary for the development of cement microstructure. This will lead to a better quality cement paste and concrete and will help to achieve the desired properties.

Construction industry use lot of water in the name of curing. The days are not so far that all the construction industry has to switch over to an alternative curing system, not only to save water for the sustainable development of the environment but also to promote indoor and outdoor construction activities even in remote areas where there is scarcity of water.

A durable concrete is one that performs satisfactorily under the anticipated exposure condition during its designed service life. In addition to the normal concrete mix some additional compounds in proper dosage and materials such as fly ash is used to increase the durability and strength of the concrete mix.

II. 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.

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)

Table 1: Physical and Chemical Properties — Polyethylene Glycol

III. Methodology

The collection of material for the self-curing concrete such as PEG 600 are 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 1 % and 1.5 % with M20 concrete and allowed for atmosphere curing. Similarly, cubes were casted for 7 and 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 18 cubes and 18 cylinder were casted for determine the strength properties.

IV. Results and Discussion

The compressive and split tensile strength of M20 grade concrete mix for 1%,1.5% of PEG-600 and conventional concrete is discussed below.

- For M20 concrete the compressive strength at the end of 7 and 28 days for 1.0% addition of PEG-600 the compressive strength showed an increasing value of 29.33 and 37.77 N/mm^2 as shown in Table.2.
- For M20 concrete the compressive strength at the end of 7 and 28 days for 1.5% addition of PEG-600 the compressive strength showed an increasing value of 28.1 and 34.22 N/mm^2 as shown in Table.2.
- Similarly, for M20 concrete the split tensile strength at the end of 7 and 28 days for 1.0% of addition of PEG-600 the split tensile strength showed an increasing trend of 10.22 and 12.88N/mm^2 as shown in Table.3.
- Similarly, for M20 concrete the split tensile strength at the end of 7 and 28 days for 1.5% of addition of PEG-600 the split tensile strength showed a decreasing trend of 8.44 and 9.33 N/mm^2 as shown in Table.3.

% of PEG-600	Compressive strength (N/mm^2)	
	7 Days	28 Days
0%	15.2	28.5
1%	29.33	37.77
1.5%	28.1	34.22

Table 2: Compressive Strength of Cubes with Varying % of PEG 600

% of PEG-600	Split tensile strength (N/mm^2)	
	7 Days	28 Days
0%	8.8	10.66
1%	10.22	12.88

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1.5%	8.44	9.33

Table 3. Split Tensile Strength of Cylinder with Varying % of PEG 600

V. CONCLUSION

The Compressive strength was found to increase for addition of 1% 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. The Compressive strength was found to increase with the addition of 1.5% of PEG-600 in M20 grade of concrete but split tensile strength showed less impressive results. 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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