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RESEARCH ARTICLE

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EFFECT OF SELF-CURING COMPOUND (using PEG-400) ON STRENGTH AND STRESS-STRAIN BEHAVIOUR OF M25 CONCRETE MIX

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ABSTRACT
Today concrete is most widely used construction material due to its good compressive strength and durability. Depending upon the nature of work the cement, fine aggregate, coarse aggregate and water are mixed in specific proportions to produce plain concrete. Plain concrete needs congenial atmosphere by providing moisture for a minimum period of 28 days for good hydration and to attain desired strength. Any laxity in curing will badly affect the strength and durability of concrete. Self-curing concrete is one of the special concretes in mitigating insufficient curing due to human negligence, inaccessibility of structures in difficult terrains and in areas where the presence of fluorides in water will badly affect the characteristics of concrete. It increases water retention capacity of mix. So many studies are done about the usage of Self curing concrete. In the present study, the affect of admixture (PEG-400) on compressive strength, stress-strain behaviour at 0.5%, 1% and 1.5% for M25 mix was studied and compared with conventional concrete.

Key words: Self-curing concrete, PEG-400, Water retention, hydration

1. INTRODUCTION

Proper curing of concrete structures is important to meet performance and durability requirements. In conventional curing this is achieved by external curing applied after mixing, placing and finishing. Self-curing or internal curing is a technique that can be used to provide additional moisture in concrete for more effective hydration of cement and reduced self-desiccation.

1.1 Methods of self curing

Currently, there are two major methods available for internal curing of concrete. The first method uses saturated porous lightweight aggregate (LWA) in order to supply an internal source of water, which can replace the water consumed by chemical shrinkage during cement hydration. The second method uses poly-ethylene glycol (PEG) which reduces the evaporation of water from the surface of concrete and also helps in water retention.

1.2 Mechanism of Internal Curing

Continuous evaporation of moisture takes place from an exposed surface due to the difference in chemical potentials (free energy) between the vapour and liquid phases. 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, thus reducing the rate of evaporation from the surface.

1.3 Significance of Self–curing

When the mineral admixtures react completely in a blended cement system, their demand for curing water (external or internal) can be much greater than that in a conventional ordinary Portland cement concrete. When this water is not readily available, significant autogenous deformation and (early-age) 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.

1.4 Materials for Internal Curing (IC)

The following materials can provide internal water reservoirs:

- Lightweight Aggregate (natural and synthetic, expanded shale)
- Super-absorbent Polymers (SAP) (60-300 nm size)
- SRA (Shrinkage Reducing Admixture) (propylene glycol type i.e. polyethylene-glycol or PEA)

2. LITERATURE REVIEW

Ole and Hansen describe a new concept for the prevention of self-desiccation in hardening cement-based materials using fine, super absorbent polymer (SAP) particles as a concrete admixture. The SAP will absorb water and form macro inclusions and this leads to water entrainment, i.e. the formation of water-filled macro pore inclusions in the fresh concrete. Consequently, the pore structure is actively designed to control self-desiccation. In this work, self-desiccation and water entrainment are described and discussed.

Roland Tak Yong Liang, Robert Keith Sun carried work on internal curing composition for concrete which includes a glycol and a wax. The invention provides for the first time an internal curing composition which, when added to concrete or other cementetios mixes meets the required standards of curing as per Australian Standard AS 3799.

Wen-Chen Jau stated that self curing concrete is provided to absorb water from moisture from air to achieve better hydration of cement in concrete. It solves the problem when the degree of cement hydration is lowered due to no curing or improper curing by using self curing agent like poly-acrylic acid which has strong capability of absorbing moisture from atmosphere and providing water required for curing concrete.

A.S. El-Dieb investigated water retention of concrete using water-soluble polymericglycol as self-curing agent. Concrete weight loss and internal relative humidity measurements with time were carried out, in order to evaluate the water retention of self-curing concrete. Water transport through concrete is evaluated by measuring absorption%, permeable voids%, water Sorptivity and water permeability.

3. SCOPE AND OBJECTIVE

- The scope of the paper is to study the effect of polyethylene glycol (PEG-200) on strength characteristics of Self-curing concrete
- The objective is study the mechanical characteristics of concrete such as compressive strength, split tensile strength and modulus of rupture by varying the percentage of PEG from 0% to 2% by weight of cement for both M20 and M40 grades of concrete.

4. EXPERIMENTAL PROGRAMME

The experimental program was designed to investigate the strength of self curing concrete by adding poly ethylene glycol PEG-400 @ 0.5%, 1% and 1.5% by weight of cement to the concrete. The experimental program was aimed to study the compressive strength, stress-strain relations. To study the above properties mix M25 was considered. The size of each cylinder is 150 mm in dia and 300 mm in height.

5. MATERIALS USED

The different materials used in this investigation are

5.1 Cement: Cement used in the investigation was 53 grade ordinary Portland cement confirming IS: 12269: 1987.

5.2 Fine aggregate: The fine aggregate used was obtained from a nearby river source. The fine aggregate conforming to zone III according to IS: 383-1970 was used.

5.3 Coarse aggregate: Crushed granite was used as coarse aggregate. The coarse aggregate according to IS: 383-1970 was used. Maximum coarse aggregate size used is 20 mm.

5.4 Polyethylene Glycol-400: Polyethylene glycol is a condensation polymer of ethylene oxide and water with the general formula, where n is the average number of repeating oxyethylene groups typically from 4 to about 180. The abbreviation (PEG) is termed in combination with anumeric suffix which indicates the average molecular weight. One common feature of PEG appears to be the water-soluble nature. The PEG-400 use in the investigation has Molecular Weight 400.

5.5 Water: Potable water was used in the experimental work for both mixing and curing purposes.

6. CASTING PROGRAMME:

Casting of the specimens were done as per IS:10086-1982, preparation of materials, weighing of materials and casting of cubes, cylinders, beams. The mixing, compacting and curing of concrete are done according to IS 516: 1959. The plain samples of cubes, cylinders were cured for 28 days in water pond and the specimens with PEG-400

7. TESTING

7.1 Stress-strain curve:

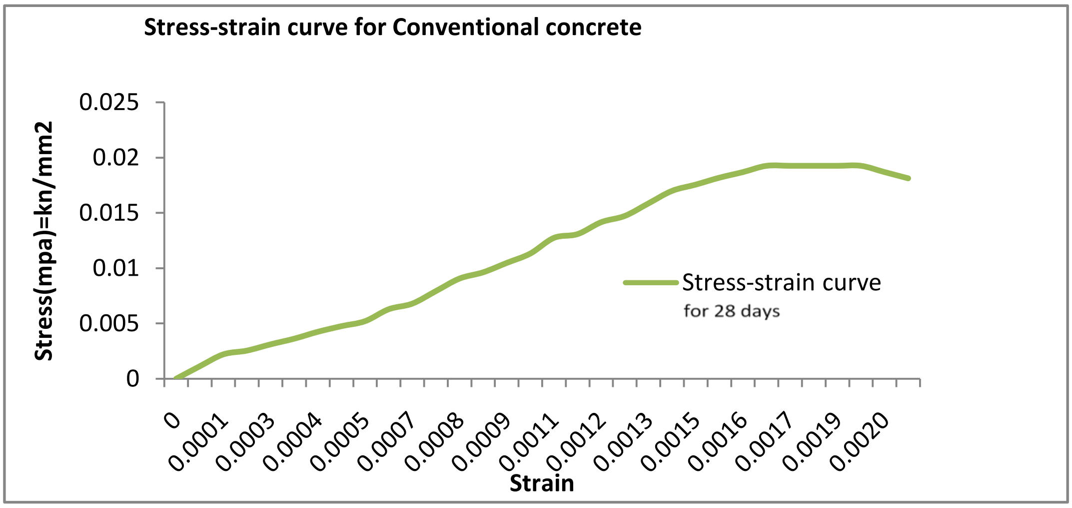
The cylinder specimens were tested on compression testing machine of capacity 2000KN.The bearing surface of machine was wiped off clean and sand or other material removed from the surface of the specimen. The specimen was placed in machine in such a manner that the load was applied on casting side of specimen. The deflections are wise by using frame. The maximum load applied on specimen was recorded.

$$f_c = P/A ,$$

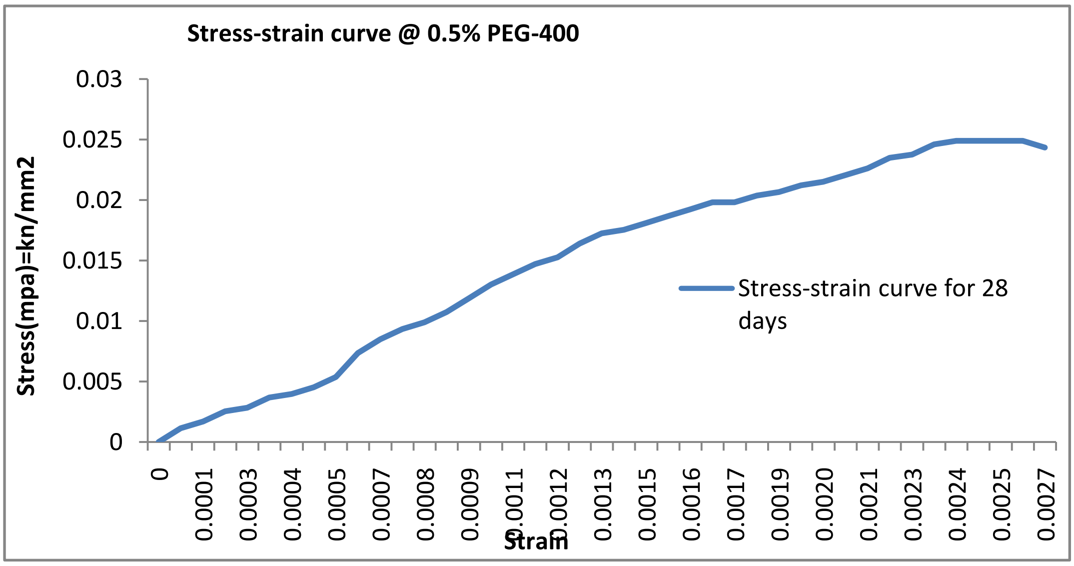
Where, P is load & A is area

8. RESULTS & DISCUSSION

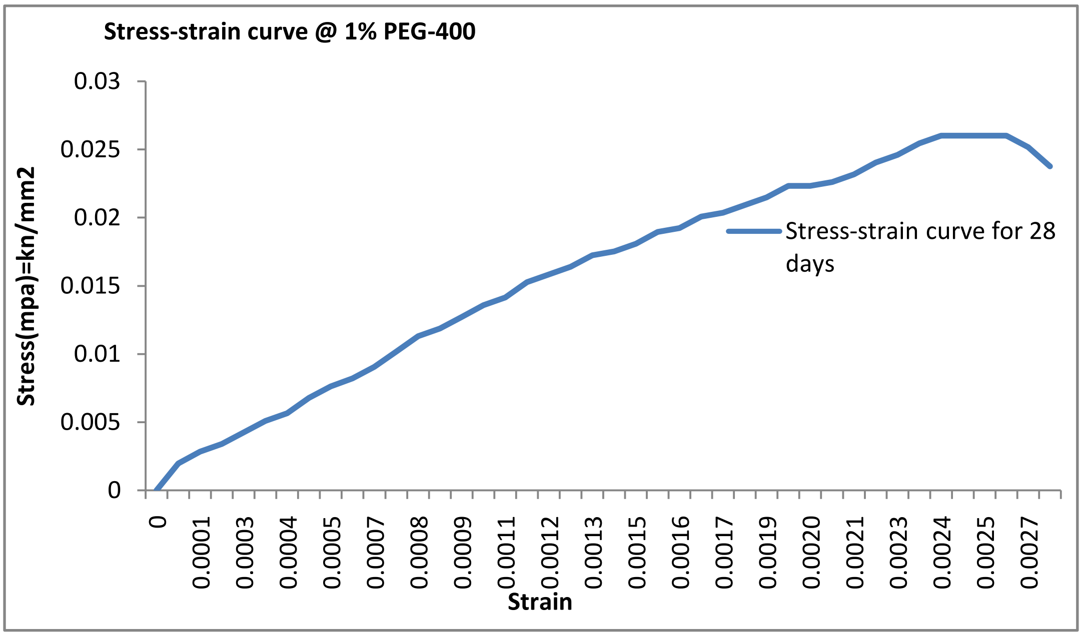
8.1 Stress strain behaviour of conventional concrete at 28 days:



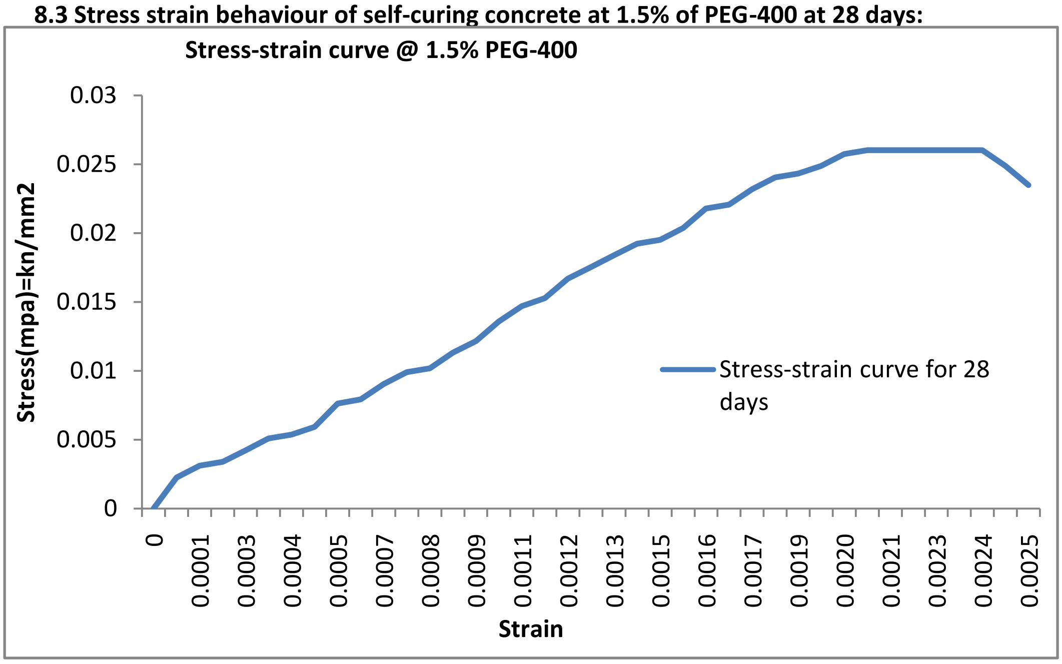
8.2 Stress strain behaviour of self-curing concrete at 0.5% of PEG-400 at 28 days:



8.3 Stress strain behaviour of self-curing concrete at 1% of PEG-400 at 28 days:



8.3 Stress strain behaviour of self-curing concrete at 1.5% of PEG-400 at 28 days:



9. CONCLUSIONS

1. Optimum Strength values for obtained at 1.5% of poly ethylene glycol-400 and good self curing agent because in the durability and normal compressive strength aspects it was giving good results when compared with both conventional concrete.
2. At the place of Water scarcity areas these types of agents will give a better result.
3. Young's Modulus of self curing concrete is also in the same range as that of conventional concrete.
4. Modulus of elasticity value for conventional concrete is 27 MPa and for self-curing concrete is 30 MPa.
5. Stress-strain behaviour for self-curing & conventional concrete is same.

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