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EXPERIMENTAL INVESTIGATION OF SELF CURING CONCRETE

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ABSTRACT

Curing of concrete is maintaining satisfactory moisture content in concrete during its early stages in order to develop the desired properties. However, good curing is not always practical and often neglected in many cases. Several investigators asked the question whether there will be self-curing concrete. Therefore, the need to develop self-curing agents attracted several researchers.The aim of this investigation is to study the strength and durability properties of concrete using water-soluble Polyethylene Glycol as self-curing agent. The function of self-curing agent is to reduce the water evaporation from concrete, and hence they increase the water retention capacity of concrete compared to the conventionally cured concrete. The use of self-curing admixtures is very important from the point of view that saving of water is a necessity everyday (each one cubic meter of concrete requires 3m^3 of water in a construction, most of which is used for curing). In this study, compressive strength and split tensile strength of concrete containing self-curing agent is investigated and compared with those of conventionally cured concrete.It is found through this experimental study that concrete cast with Polyethylene Glycol as self-curing agent is stronger than that obtained by sprinkler curing as well as by immersion curing.

KEYWORDS:curing, concrete, self-curing agent

INTRODUCTION

During the last two decades, concrete technology has been undergoing rapid developments. In recent years, the concept of internal curing of concrete has gained popularity and is steadily progressing from laboratory to field of practice. 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’’. Typically, an additional internal water is supplied via the incorporation of saturated lightweight fine aggregates or polyethylene-glycol which causes reduction of the surface tension of the mixing water and reduces the water evaporation from concrete and hence increases the water retention capacity of the concrete. The benefits of internal curing are numerous and include, increased hydration process and strength development, reduced autogenous shrinkage and cracking, reduced permeability, and increased durability. The impact of internal curing begins immediately with the initial hydration of the cement, so that its benefits are observed at ages as early as 2 days or 3 days. Internal curing is beneficial in low water–cement ratio (w/c) concretes because of the chemical shrinkage that accompanies Portland cement hydration and the low permeability of these materials. Since the water incorporated into and absorbed by the cement hydration products has a specific volume less than that of bulk water, a hydrating cement paste will imbibe water (about 0.07 g water/g cement) from available sources. While in higher w/c concretes, this water can be and often is supplied by external (surface) curing. In low w/c concretes, the permeability of the concrete quickly becomes too low to allow the effective transfer of water from the external surface to the concrete interior. Hence, one has the justification for internal curing. If additional water can be distributed somewhat uniformly throughout the concrete, it will be readily available to migrate to the nearby cement paste and participate in the hydration process as needed.

The recent trend in concrete technology toward the so-called high-performance, or low water/solid binder mass ratio (w/b), concretes encountered some problems. One of the major problems with such a mixture is its increased tendency to undergo early-age cracking. While this cracking may or may not compromise the (higher) compressive strength of these concretes, it likely does compromise their long-term durability. The phenomenon of early-age cracking is complex and depends on thermal effects, autogenous strains and stresses, drying, stress relaxation, and structural detailing and execution. In concretes with low w/binder ratio, a major contributor to

early-age cracking can be the autogenous shrinkage induced by the self-desiccation that occurs during hydration under sealed or partially saturated conditions. As the cementitious materials hydrate under sealed conditions, empty porosity is created within the ‘‘set’’ microstructure, because the hydration products occupy less volume than the reacting materials. The water menisci created by these empty pores in turn induce compressive stresses in the three dimensional microstructure. The magnitude of these stresses is influenced by both the surface tension of the pore solutionand the meniscus radius of the largest water-filled pore within the microstructure. Concrete incorporating self-curing agents will represent a new trend in the concrete construction in the new millennium, due to the increased use of high-performance concrete. Several techniques may, potentially, be used for incorporation of internal curing water in concrete. Several researchers have proposed the use of saturated light weight aggregates to provide ‘‘internal’’ curing for concrete. On the other hand, other researchers used poly-glycol products in concrete mixes as self-curing agent.
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NECESSITY

The necessity of this study is to mitigate insufficient curing due to human negligence, scarcity of water in arid areas, inaccessibility of structures in difficult terrains and in areas where the presence of fluorides in water will badly affect the characteristics of concrete. The literatures indicate that some studies are available on use of PEG400 as a curing agent which results in same mechanical properties of concrete and durability as compared with conventionally cured concrete. An attempt is made in this work to study and investigate effect of PEG400 as a curing agent on mechanical properties and durability of concrete as compared with conventionally cured concrete.

OBJECTIVE

The main objective of this study is to compare the physical properties of hardened concrete and durability of conventional cured concrete with the curing agent used concrete with which we can determine increase in strength, durability and decrease in permeability of concrete or not as compare to the normally cured concrete. Hence the optimum percentage of curing agent will be used for improving the mechanical properties of concrete along with the economy.

METHODOLOGY

Destructive test conducted on Concrete

- **Compressive Strength Test:**

A cube compression test is performed on standard cubes of size 150 x 150 x 150 mm after 3, 7 and 28 days of immersion in water for curing. The compressive strength of specimen is calculated by the following formula:

$$f_{cu} = P_c / A$$

Where
Pc = Failure load in compression, KN
A = Loaded area of cube, mm2

- **Split Tensile Test:**

The split tensile test is well known indirect test used to determine the tensile strength of concrete. Due to difficulties involved in conducting the direct tension test, a number of indirect methods have been developed to determine the tensile strength of concrete. In these tests, in general a compressive force is applied to a concrete specimen in such a way that the specimen fails due to tensile stresses induced in the specimen.
P

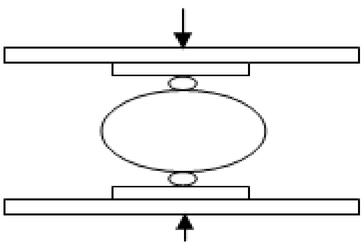

Fig 1 Cylinder split tensile test setup

The split tensile strength of cylinder is calculated by the following formula,

$$f_t = 2P / \pi LD$$

Where,
f_t = Tensile strength, MPa
P = Load at failure, N
L = Length of cylinder, mm
D = Diameter of cylinder, mm

- **Flexural Test:**

Standard beams of size 150 x 150 x 700mm are supported symmetrically over a span of 400mm and subjected two points loading till failure of the specimen.

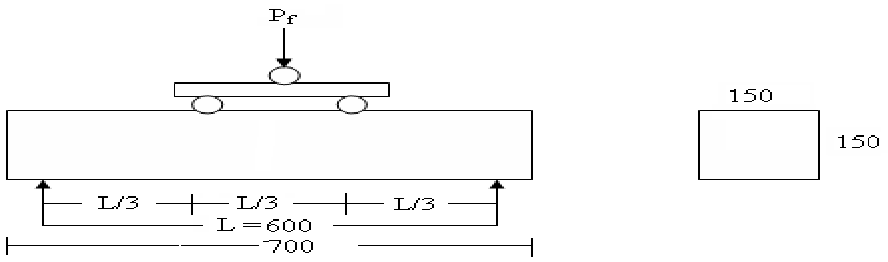

Fig 2 Two point loading setup in flexure test

The flexural strength is determined by the formula

$$f_{cr} = P_f L / bd^2$$

Where, f_{cr} = Flexural strength, MPa
P_f = Central point through two point loading system, KN
L = Span of beam, mm
b = Width of beam, mm
d = Depth of beam, mm

CONCLUSION

- The optimum dosage of PEG400 for maximum strengths (compressive and tensile) was found to be 0.3% for M20 grades of concrete.
- Strength of self-curing concrete is on par with conventional concrete.
- Self-curing concrete is the answer to many problems faced due to lack of proper curing.
- No serious degradation in durability related properties was revealed.

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