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Study On Fibre Reinforced Self Curing Concrete

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***Abstract*— Internal curing as "supplying water throughout a freshly placed cementitious mixture using reservoirs, via pre-wetted lightweight aggregates, that readily release water as needed for hydration or to replace moisture lost through evaporation or self-desiccation" (American Concrete Institute, 2010). Self curing Concrete is known to be easily cracked under, low level tensile stress, for its inherent weakness in resisting tensile forces. Incorporation of fibres into the concrete is not only an effective way to enhance concrete tensile stress, but also fracture toughness, impact strength, durability, etc. Fibers is usually used in concrete to control cracking due to both plastic shrinkage and drying shrinkage..**

I. Introduction

Concrete is most widely used construction material in the world due to its ability to get cast in any form and shape. It also replaces old construction materials such as brick and stone masonry. The strength and durability of concrete can be changed by making appropriate changes in its ingredients like cementitious material, aggregate and water and by adding some special self curing ingredients like pumice and steel fibres. Hence self curing concrete can use very well suitable for a wide range of applications. In this experimental work pumice is used as a self curing agent or a water reservoir in concrete, and steel fibres used to improve the strength properties of concrete. The use of Steel Fibers in Concrete in building structures, which may improve the toughness, flexural strength, tensile strength, impact strength as well as the failure mode of the concrete. Use of fibers into Self curing concrete mixes has been presented by many researchers. Depending on many parameters such as maximum aggregate size, fiber volume, fiber type, fiber geometry, and fiber aspect ratio, fiber inclusion to concrete reduces the workability of concrete. The basic concept of this technology is to provide water for concrete, so that it can continue the curing process on its own. This is done by embedding the water inside the materials used to make concrete. If the water just added as mixing water; this would lead to many other quality related problems, such as bleeding, segregation, and etc. The self curing technology has been intentionally incorporated into concrete mixtures at the proportioning stage, using a variety of materials including pre-wetted lightweight aggregates, pre-wetted crushed returned concrete fines, superabsorbent polymers, and pre-wetted wood fibres.

Most of the concrete that was produced and placed each year all over the world already does self-cure to some extent. Some of it is not intended to have anything done to its exterior surface, except perhaps surface finishing. Yet the concrete's ability to serve its intended purpose is not significantly reduced [1].

Curing is the maintaining of a satisfactory moisture content and temperature in concrete during its early stages so that desired properties (of concrete) may develop. Curing is essential in the production of concrete that will have the desired properties. The strength and durability of concrete will be fully developed only if it is cured. No action to this end is required, however, when ambient conditions of moisture, humidity, and temperature are sufficiently favorable to curing. Otherwise, specified curing measures shall start as soon as required. [1]

Proper curing of concrete structures is important to ensure that they meet their intended performance and durability requirements. Curing plays a major role in developing the concrete microstructure and pore structure. Self curing distributes the extra curing water throughout the entire 3-D concrete microstructure so that it is more readily available to maintain saturation of the cement paste during hydration, avoiding self-desiccation and reducing autogenous shrinkage. The scope of the research included characterization of super absorbent polymer for use in self curing. Experimental measurements were performed on to predict the compressive strength, split tensile strength and flexural strength of the concrete containing Super Absorbent Polymer (SAP) at a range of 0%, 0.2%, 0.3%, and 0.4% of cement and compared with that of cured concrete. The grade of concrete selected was M40. Addition of SAP leads to a significant increase of mechanical strength (Compressive and Split tensile) Maximum compressive stress develop in M-40 grade self curing concrete by adding sap 0.3% of cement. Split tensile strength of self curing concrete for dosage of SAP 0.3% of cement was higher than non self curing concrete. Flexural strength of self curing concrete for dosage of SAP 0.3% of cement was higher than non self curing concrete. Performance of the self-curing agent will be affected by the mix proportions mainly the cement content and the w/c ratio. (Amal Francis k, 2013 et al.)

II. MATERIALS AND EXPERIMENTATION

Cement: In this experimental work, ordinary Portland cement (OPC) 43 grade conforming to IS: 8112 – 1989 was used.

Sand: Locally available river sand zone II with specific gravity 2.58, water absorption 1% and conforming to I.S. – 383-1970.

Coarse aggregate: Crushed granite stones of 20 mm down size, having a specific gravity of 2.61 conforming to IS 383-1970

Water: Potable water was used for the experiment.

Pumice: Lightweight aggregates having density 624 kg/m3 and specific gravity 0.84.

Steel Fibers: - In this experimentation Flat Steel fibers were used, having length38mm and 2mm width. Tha aspect ratio of the steel fibre is 95.

III. Experimental methodology

The experimentations were designed for M30 grade of concrete and the concrete mix containing 2% steel fibers(volume fraction) and the pumice aggregates by replacing coarse aggregates in different percentages, such as 0%, 10%, 20%, 30%, 40%, and 50%. The different near surface characteristics such as water absorption and sorpitivity tests and strength characteristics that are studied are, compressive strength, tensile strength, flexural strength and shear strength. The specimens are cast by soaking the pumice stone in water and then tested after 28 days, air curing. Another set of specimens was cast without soaking the pumice stone in water and curing the specimen for 28 days. The results will be compared to study the characteristic behavior of self-cured concrete by using pumice aggregates in different percentages.

IV. EXPERIMENTAL RESULTS

Water absorption test results

Following fig. 1 shows the variation of water absorption graphically. The water absorption test results of self cured fibre reinforced concrete for different percentage replacement of coarse aggregate by pumice.

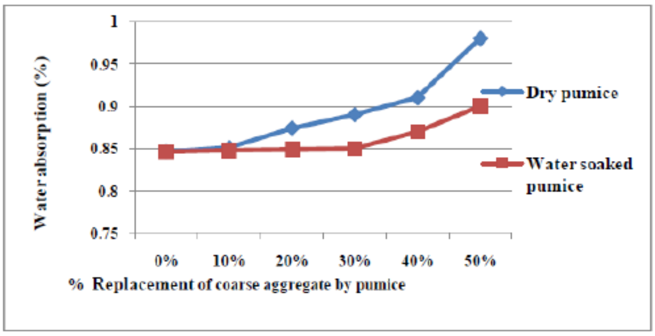

Fig. 1 Variations of water absorption

Sorptivity test results

Following Fig. 2 shows the variation of water absorption graphically. The water

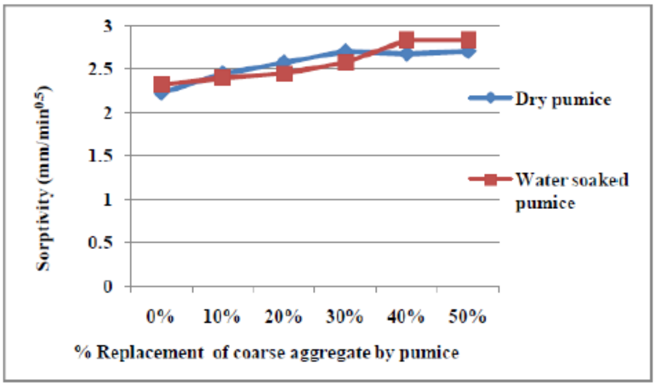

Fig. 2: Variation of sorptivity

Strength test results

Compressive strength test results.

The following fig shows the results of variation of the compressive strength is depicted in the form of graph as shown in fig. 3. This gives the overall results of tensile strength of fibre reinforced concrete. When coarse aggregates are replaced by pumice aggregates in different percentages and then subjecting them to water curing and air curing.

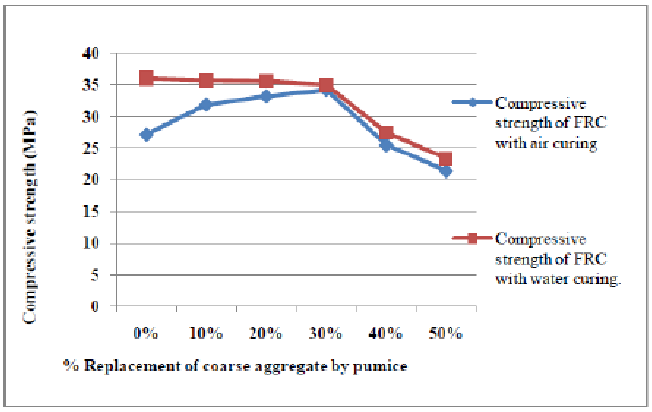

Fig. 3: Variation of compressive strength

It is observed that the compressive strength of concrete with air curing goes on increasing up to 30% replacement of coarse aggregates by pumice aggregates. Their after the compressive strength decreases. A compressive strength 34.22 MPa is obtained when 30% of coarse aggregates are replaced by pumice aggregates. This may be due to the fact that 30% replacement of coarse aggregates by pumice aggregates may hold water just sufficient to carry out the internal curing of concrete. Thus, it can be concluded that the self cured steel fibre reinforced concrete produced with 30% replacement of coarse aggregates by pumice aggregates will yield higher compressive strength.

It is observed that the compressive strength of concrete with water curing goes on decreasing replacement of coarse aggregates by pumice aggregates. This may be due to the fact that without replacement of coarse aggregates by pumice aggregates and with water curing may show perfect compatibility.

Tensile strength test results

Following fig shows the variation of tensile strength of fibre reinforced concrete, when coarse aggregates are replaced by pumice aggregates in different percentages and then subjecting them to water curing and air curing.

It is observed that the tensile strength of concrete with water curing at 0% replacement of coarse aggregates by pumice aggregates. Their after the tensile strength decreases. A tensile strength 3.70 MPa is obtained when 0% of coarse aggregates are replaced by pumice aggregates.

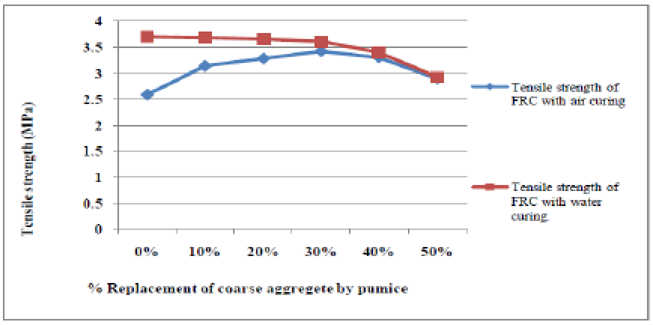

Fig. 4: Variation of tensile strength

Flexural strength test results

Following fig shows results of variation of the flexural strength of fibre reinforced concrete, when coarse aggregates are replaced by pumice aggregates in different percentages and then subjecting them to water curing and air curing.

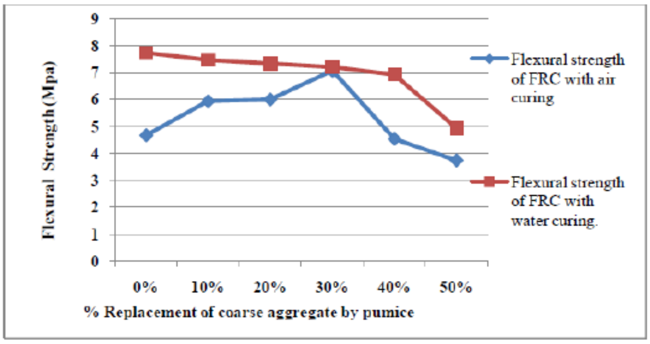

Fig. 5: Variation of flexural strength

It is observed that the flexural strength of concrete with air curing goes on increasing up to 30% replacement of coarse aggregates by pumice aggregates. Their after the flexural strength decreases. A flexural strength of 7.06 MPa is obtained when 30% of coarse aggregates are replaced by pumice aggregates. This may be due to the fact that 30% replacement of coarse aggregates by pumice aggregates may hold water just sufficient to carry out the internal curing of concrete. It is observed that the flexural strength of concrete with water curing at 0% replacement of coarse aggregates by pumice aggregates. Their after the flexural strength decreases. A flexural strength 7.73 MPa is obtained when 0% of coarse aggregates are replaced by pumice aggregates.

CONCLUSIONS

- The self cured steel fibre reinforced concrete produced with 30% replacement of coarse aggregates by pumice aggregates will yield higher compressive strength.
- The concrete produced without replacement of coarse aggregates by pumice aggregates and with water curing show higher compressive strength.
- It can be concluded that the compressive strength of self cured steel fibre reinforced concrete will be slightly affected.
- The self cured steel fibre reinforced concrete produced with 30% replacement of coarse aggregates by pumice aggregates will yield higher tensile strength.
- The concrete produced without replacement of coarse aggregates by pumice aggregates with water curing show higher tensile strength.
- It can be concluded that the tensile strength of self cured steel fibre reinforced concrete will be slightly affected.
- The self cured steel fibre reinforced concrete produced with 30% replacement of coarse aggregates by pumice aggregates will yield higher flexural strength.
- The concrete produced without replacement of coarse aggregates by pumice aggregates show higher flexural strength.
- It can be concluded that the flexural strength of self cured steel fibre reinforced concrete will be slightly affected.

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