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AN INVESTIGATION ON THE PROPERTIES OF SELF CURING POLYPROPYLENE FIBER REINFORCED CONCRETE

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Abstract - *Proper curing of concrete structures is important to meet performance and durability requirements. Self-curing or internal curing is a technique that can be used to provide additional moisture in concrete for more effective hydration of cement. In this experimental investigation, the behavior of fiber reinforced self-cured concrete containing polypropylene fibers at 5% and cinders aggregate as self-curing agent is determined. The experiments are designed by replacing the coarse aggregates by cinders aggregates in various percentages. Different strength characteristics that are studied are compressive strength, tensile strength and flexural strength. Cinders aggregates are used in concrete with soaking and without soaking in water. The specimens are tested after 28 days curing period. From the result obtained it is seen that the compressive strength, split tensile strength and flexural strength of polypropylene fiber reinforced concrete goes on increases till 30% replacement of coarse aggregate with wet cinders aggregate and then it decreases. And the compressive strength, split tensile strength and flexural strength of polypropylene fiber reinforced concrete goes on decreases as the replacement of coarse aggregate with dry cinder aggregates increases*

***Key Words*: Polypropylene fibre, cinders, self-curing concrete, compressive strength, tensile strength, flexural strength**

1. INTRODUCTION

Proper curing of concrete structures is important to ensure they meet their intended performance and durability requirements. In conventional construction, this is achieved through external curing, applied after mixing, placing and finishing. Internal curing (IC) is a very promising technique that can provide additional moisture in concrete. Internal curing is often also referred as Self–curing. Self-curing concrete is known to be easily cracked under low level tensile stress, for its inherent weakness in resisting tensile forces. Incorporation of fibers into concrete is not only an effective way to enhance concrete tensile stress, but also fracture toughness, impact strength, durability, etc. Lightweight aggregates were primarily used to reduce the weight of concrete structures; however, these aggregates were usually saturated prior to use in concrete to ensure adequate workability, since it was recognized that dry porous aggregates could absorb some of the mix water in fresh concrete. These concrete structures were found to achieve long-term durability from their excellent in-service performance observed in the field.

1.1 Objectives

The main objective of this experimental investigation is to find out the behavior of fiber reinforced self-cured concrete containing polypropylene fibers at 0.5% and cinders aggregate as self-curing agent. The experiments are designed by replacing the coarse aggregates by cinders aggregates in different percentages, such as 0%, 10%, 20%, 30%, 40% and 50%. Different strength characteristics that are studied are compressive strength, tensile strength, flexural strength. Cinders aggregates are used in concrete with soaking and without soaking in water. The specimens are tested after 28 days curing period.

2. MATERIALS AND METHODOLOGY

Cement: In this experimental work, Portland Pozzolana cement (PPC) was used.

Manufactured sand: The crushed sand is of cubical shape with grounded edges was used.

Coarse aggregate: Crushed aggregates of 20 mm down size, having specific gravity of 2.84 were used.

Water: Water fit for drinking is generally considered fit for making concrete.

Cinders aggregate: Light weight aggregate having density 1.8 were used.

Polypropylene fibers: Polypropylene fibers having the specific gravity 0.91 are used.

The experimentations are designed by replacing the coarse aggregates by cinders aggregates in various percentages, such as 0%, 10%, 20%, 30%, 40% and 50%. Different strength characteristics that are studied are compressive strength, tensile strength and flexural strength. Cinders aggregates are used in concrete with soaking and without soaking in water. The specimens are tested after 28 days curing period.

Water absorption test

To determine the water absorption of specimens, three specimens were dried at a room temperature for 24 hours and its weight is determined as initial weight (W1). The specimens were then immersed in water for 24 hours and its saturated surface dry weight was recorded as the final weight (W2). Water absorption of specimens is reported as follows.

Percentage water absorption = [(W2-W1) / W1] X 100

Sorptivity test

Sorptivity test determines the rate of capillary–rise absorption by a concrete prism which rests on small supports in a manner such that only the lowest 30 mm of the prism is submerged. The increase in the water level of the prism with time is recorded. It has been shown that there exists a relation of the form,

$$S = (i / t^{0.5})$$

Compressive strength test

In order to determine the compressive strength of concrete, cube specimen of dimension 150 x 150 x 150 mm were casted. After 28 days curing, these cubes were tested. Compressive strength was calculated as follows

Compressive strength = (P / A) × 1000

Tensile strength test

Cylinder specimens of dimension 150 mm diameter and 300 mm length were casted. These specimens were tested after 28 days curing period. Tensile strength was calculated as follows

Split tensile strength = (2P/πdL)

Flexural strength test

In order to determine the flexural strength of concrete, beam specimens of dimension 100 x 100 x 500 mm were casted and tested after 28 days of curing period. Flexural strength was calculated as follows

Flexural strength = [(PL / bd²) X 1000]

3. EXPERIMENTAL RESULTS

3.1 Water absorption test

Chart -1 shows the variation of water absorption graphically for self-cured fiber reinforced concrete with different percentage replacement of coarse aggregate by cinders.

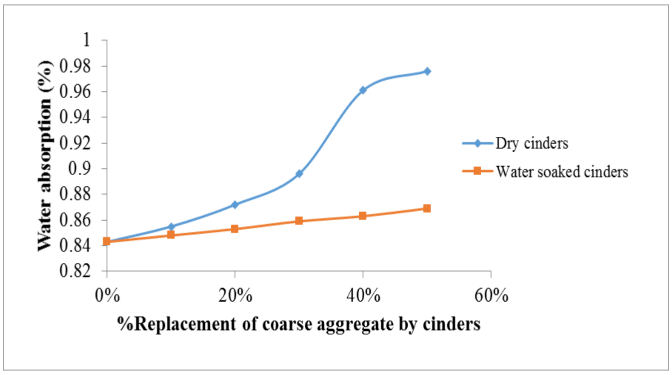

Chart -1: Variation of water absorption

3.2 Sorptivity test result

Chart-2 shows the variation of water absorption graphically.

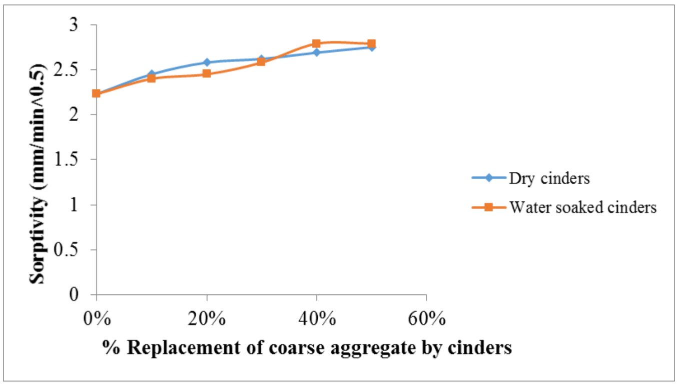

Chart -2: Variation of Sorptivity

3.3 Compressive strength test results

The variation of the compressive strength is depicted in the form of graph as shown in Chart-3.

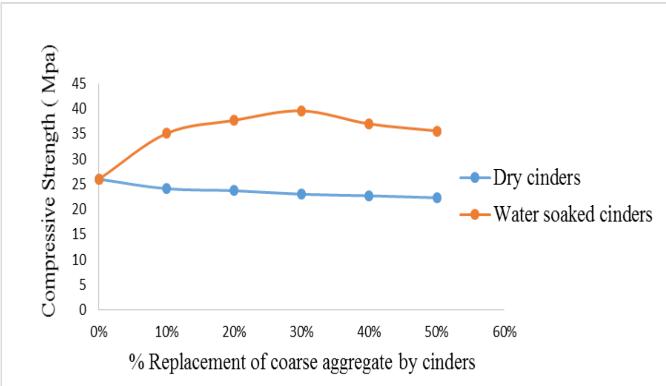

Chart -3: Variation of Compressive strength

3.4 Tensile strength test results

The variation of the tensile strength is depicted in the form of graph as shown in Chart-4.

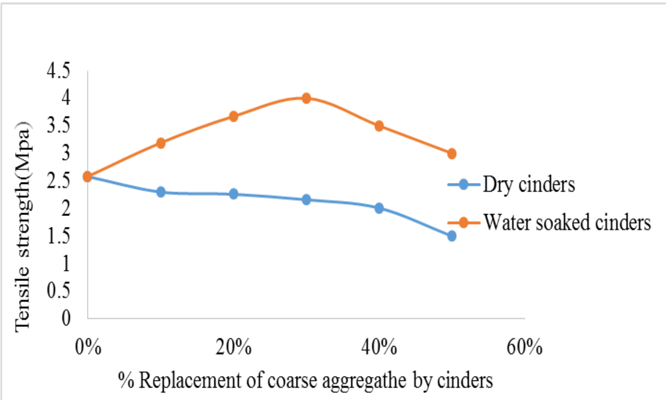

Chart -4: Variation of Tensile strength

3.5 Flexural strength test results

The variation of the flexural strength is depicted in the form of graph as shown in Chart-5.

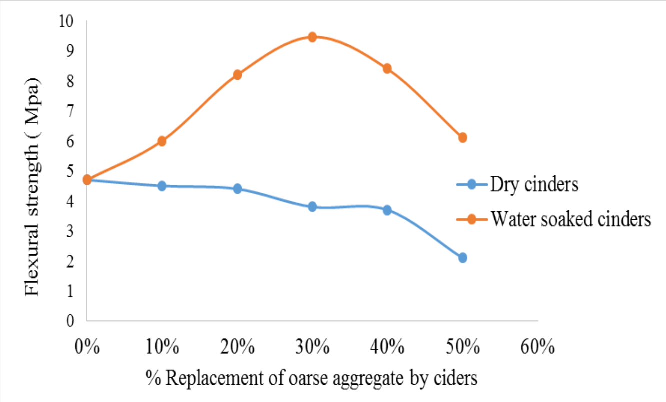

Chart -5: Variation of Flexural strength

4. DISCUSSIONS ON OBSERVATION

It is observed that the water absorption capacity and sorptivity value goes on increasing with percentage replacement of coarse aggregate with cinders increases. Water absorption capacity is more for dry cinders compared to wet cinders.

It is observed that the compressive strength of polypropylene fiber reinforced concrete goes on increasing up to 30% replacement of coarse aggregates by water saturated cinders aggregates. There after the compressive strength decreases. A compressive strength 39.6 MPa is obtained when 30% of coarse aggregates are replaced by water saturated cinders aggregates. This may be due to the fact that 30% replacement of coarse aggregates by water saturated cinder aggregates may hold water just sufficient to carry out the internal curing of concrete. It is observed that the compressive strength of polypropylene fiber reinforced concrete goes on decreasing as the percentage replacement of coarse aggregates by dry cinder aggregates increases. This may be due to the fact that the replacement of coarse aggregates by dry cinder aggregates are unable to cure the concrete internally.

It is observed that the tensile strength of polypropylene fiber reinforced concrete goes on increasing up to 30% replacement of coarse aggregates by water saturated cinder aggregates. There after the tensile strength decreases. A tensile strength of 4 MPa is obtained when 30% of coarse aggregates are replaced by water saturated cinder aggregates. This may be due to the fact that 30% replacement of coarse aggregates by water saturated cinder aggregates may hold water just sufficient to carry out the internal curing of concrete. It is observed that the tensile strength of polypropylene fiber reinforced concrete goes on decreasing as the percentage replacement of coarse aggregates by dry cinder aggregates increases. This may be due to fact that the replacement of coarse aggregates by dry cinder aggregates are unable to cure the concrete internally.

It is observed that the flexural strength of polypropylene fiber reinforced concrete goes on increasing up to 30% replacement of coarse aggregates by water saturated cinder aggregates. There after the flexural strength decreases. A flexural strength of 9.46 MPa is obtained when 30% of coarse aggregates are replaced by water saturated cinder aggregates. This may be due to the fact that 30% replacement of coarse aggregates by water saturated cinder aggregates may hold water just sufficient to carry out the internal curing of concrete. It is observed that the flexural strength of polypropylene fiber reinforced concrete goes on decreasing as the percentage replacement of coarse aggregates by dry cinder aggregates increases. This may be due to fact that the replacement of coarse aggregates by dry cinders aggregates are unable to cure the concrete internally.

5. CONCLUSIONS

The self-cured polypropylene fiber reinforced concrete produced with 30% replacement of coarse aggregates by water saturated cinders aggregates will yield higher compressive strength and it gives 8.49% increase in the compressive strength compared to the reference concrete.
The compressive strength of polypropylene fiber reinforced concrete goes on decreasing as the percentage replacement of coarse aggregates by dry cinder aggregates increasing.
The self-cured polypropylene fiber reinforced concrete produced with 30% replacement of coarse aggregates by water saturated cinder aggregates will yield higher tensile strength and it gives 11.1 % increase in tensile strength compared to the reference concrete.
The tensile strength of polypropylene fiber reinforced concrete goes on decreasing as the percentage replacement of coarse aggregates by dry cinder aggregates increases.
The self-cured polypropylene fiber reinforced concrete produced with 30% replacement of coarse aggregates by water saturated cinder aggregates will yield higher flexural strength and it gives 22.3 % increase in the flexural strength compared to the reference concrete.
The flexural strength of polypropylene fiber reinforced concrete goes on decreasing as the percentage replacements of coarse aggregates by dry cinder aggregates increases.

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