Performance Analysis of Self Curing Concrete using Super Absorbent Polymer with Recycled Coarse Aggregate

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Abstract
Water is a vital material for curing process in construction field. It plays an important role in the aspects of early strength, durability and performance of concrete. Keeping this in mind, an attempt has been made using Super Absorbent Polymer (SAP) as self-curing agent and Recycled Coarse Aggregate (RCA) as filler by 25%, 50%, 75% of weight in place of normal coarse aggregate. The strength and durability properties of concrete are determined experimentally.

Keywords: Self curing, Super Absorbent Polymer, Recycled Coarse Aggregate (RCA).

Introduction

Concrete is a mixture of cement, fine and coarse aggregate, water and admixtures which hardens over time. Curing plays a very significant role in concrete performance. Sufficient water must be available for concrete, for the chemical reaction to take place between water and cement. During this process temperature increases inside the concrete and becomes dry. It is essential to control the temperature inside the concrete. Self curing technology is important to meet the demand of good water.

Super Absorbent Polymer (SAP): Hydration process in concrete is predominately important for its strength. During hydration process, due to temperature increase water is utilized in lager amount and the water used for curing is not sufficient. To solve this, superabsorbent polymer (SAP) plays a vital role. When absorbent material like superabsorbent polymer (SAP), is used in concrete the water from SAP acts as internal curing water from the inside out during hydration process. Water is slowly released by the absorbent material to concrete when the relative humidity inside the cement matrix gradually drops. This helps in reducing the micro cracks in cement matrix and relieves the autogenous and drying shrinkage. Then the strength and durability of the concrete can be improved.

Research work on SAP concrete has been carried in recent years and its influence on the construction performance, strength and durability of concrete has been studied. Both positive and negative effects results in addition of on concrete properties. The research conducted by Dudziak and Mechtcherine indicated that introduction of SAP in concrete reduces the slump of the concrete, additional internal curing water absorbed by the SAP was needed to compensate for the moisture in concrete.

Recycled coarse aggregate: Demolition waste of building leads to Waste generation in construction field. Recycling is most effective method for reducing the increasing volume of waste. Waste concrete is recycled and it is used as Recycled coarse aggregate (RCA). This method of using RCA helps in reducing impact on environment. In the present study recycled coarse aggregate have been used to replace virgin coarse aggregate. The properties of fresh as well as hardened concrete made of partial/full replacement of recycled coarse aggregate are found out and the results are compared with that of concrete using virgin coarse aggregate. RCA where add in the form of 25% 50% 75%.

Material and Methods

Sodium-poly-acrylate (C3H3NaO2)n with density of 1.22 g/cm3 with bio- tech grade was used. It was obtained from A.S. Innovations & Agro, Nashik. Ordinary Portland cement make Ultra Tech of grade 53 is used for binding material for the work. The fineness of the cement is 8% and its specific gravity is 3.15. Normal coarse aggregate of specific gravity 2.63 with water absorption of 0.31%, RCA of specific gravity 2.56 with water absorption of 0.34% and M sand of specific gravity 2.68 and bulking of 11.1% was used. Mix design of 1:1.68:2.84 and water cement ratioof0.45 was used for casting of specimens for the experiments. All the tests were conducted based on the IS codes. Three samples were tested for each category and the average values are reported.

Results and Discussion

Cubes were casted with mix proportion and water cement ratio as mentioned in the previous part with RCA and addition of SAP. The casted cubes were tested after 7days and 28days of curing. The strength performance with the conventional concrete is compared and reported in this section.

a. Compressive strength of normal concrete & RCA added concrete: Table 1 shows the compressive strength of the normal concrete tested after 7 days and 28 days. It was observed that the normal concrete had a compressive strength of 19.3 MPa and 36.01 MPa for 7 and 28 days of curing respectively. It was observed that the cubes with 25% RCA had an increase in the compressive strength by 12% after 7 days of curing compared to normal concrete. But the compressive strength was found to decrease by 13% for cubes cat with 25% RCA after 28 days of curing compared to normal concrete after 28 days. Similar observations were made for the cubes casted with 50% and 75% RCA.

Comparing the result it is concluded that 50 % RCA had comparable compressive strength with normal concrete.

Table 1
Compressive Strength of Normal Concrete and RCA Filled Concrete

No of days of curing	Compressive strength (MPa)			
	Normal	25% RCA	50% RCA	75% RCA
7 days	19.3	22	20.3	18.8
28 days	36.01	31	32.33	30.06

b. Split Tensile Test of Normal Concrete & RCA Added Concrete: Split tensile strength of concrete filled with RCA and normal is determined after 28 days of curing. The split tensile strength of the cubes with normal and RCA filled concrete is shown in table 2. It was observed that there is a gradual increase in split tensile strength for RCA filled cubes while increasing the RCA wt% compared to the normal concrete. There is an increase of split tensile strength by 7.35%, 13% and 23% for 25%, 59% and 75% RCA respectively compared to the normal concrete. The reason that could be attributed for the increase in split tensile strength would be due to improper treatment of RCA.

Table 1
Split Tensile Strength of Normal Concrete and RCA Filled Concrete

No of days of curing	Split tensile strength (N/mm^2)			
	Normal	25% RCA	50% RCA	75% RCA
28 days	2.52	2.72	2.87	3.1

Conclusion

Concrete cubes were casted with SAP with normal filler and RCA under varying proportions and tested for its compressive strength and split tensile strength. The following are the conclusions.

1. It has been observed that 7 days compressive strength of conventional concrete is achieved when 25 % of RCA is been used whereas 28 days compressive strength of conventional concrete in close proximity when 50% of RCA is used. Primary reason for the strength reduction may be due to the adhered mortar to the RCA and other non- aggregate materials. This can be corrected by using proper cleaning technique of RCA under skilled supervision.

2. It has also been observed that split tensile strength has increased gradually compared to normal concrete.

3. It is concluded that 50 % RCA with SAP had optimal properties for compressive strength and while the split tensile strength had an increased value.

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