EXPERIMENTAL STUDIES ON CONCRETE REPLACING FINE AGGREGATE WITH QUARRY DUST WASTES

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Abstract
Concrete is the most undisputable and indispensable material being used in infrastructure development throughout the world. Many investigations were done to produce various varieties of concrete by reusing waste materials. Fine Aggregate (FA) plays a major role in making of concrete and the availability of fine aggregate is dwindling due to it's over explosion throughout the world. In this context an experimental studies was done based on Quarry Dust Wastes (QDW) for replacement of fine aggregate in concrete. Compressive strength tests were carried out with different proportions of replacements of FA with QDW. It was observed that on 75% substitution of FA with QDW the compressive strength of concrete was within permissible limit for use in construction industry.

Key words: - Pozzolana Portland Cement, Quarry Dust Waste, Concrete, Compressive strength.

I. Introduction

Explosion in population coupled with rapid industrialization and subsequent demand for infrastructure facilities has ushered a need to provide the necessary civil engineering structures. As the resources available for construction are limited, there is a need to go for some alternatives and use of industrial wastes appears to be an attractive option. Several waste materials such as spent fire bricks and recycled aggregate were used as replacements to concrete with varying compressive strength values

S. Keerthinarayana et.al.,[2] had studied the strength and durability properties by partial replacement of fine aggregate with crushed spent fire bricks and have reported an increase in the compressive strength with the partial replacement of CFBS. Malek Batayneh et.al.,[3] have successfully demonstrated the application of demolished concrete, glass and plastics as partial substitutes to concrete. J. Selwyn Babu et.al.,[9] had studied the physical and mechanical properties of concrete, replacing fine aggregate with GGBFS and BFS.

Quarry Dust Waste (QDW) has the same phycial characteristics of fine aggregate, as its size and properties are very to sand. In this investigation it is proposed to utilize Quarry Dust Waste (QDW) as replacement in the fine aggregate in different proportions.

II. Materials and Methods

A. Cement

In this present investigation Pozzolana Portland Cement (PPC) was used.

B. Fine Aggregate (FA)

The sand used for the experimental procedure was locally procured from a river

and confirmed to Indian Standard Specifications [4]. It was passed through a 4.75 mm sieve, washed to remove any dust and then used as it was for further investigations.

C. Coarse Aggregate (CA)

Broken granite stones are generally used as a Coarse Aggregates (CA). The nature of work decides the maximum size of the CA. Locally available CA having the maximum size of 20 mm was used in our work. The aggregates were washed to remove any dust and were dried. The aggregates were tested as per Indian Standard Specifications [4].

D. Water

Water is an important ingredient of concrete s it actually participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water required is to be looked into very carefully. In practice, very often great control on properties of cement and aggregate is exercised but the control on the quality of water is often neglected. So quality of water is checked to its purity.

E. Quarry Dust Wastes (QDW)

The QDW is the by product which is formed in the processing of the granite stones. QDW has the same physical characteristics to sand. It was made to pass through a 4.75 mm sieve [4], washed and used for further studies.

F. Methodology

Cement used for the study was tested for the parameters, Fineness, Consistency, Initial & Final Setting times and Specific Gravity [6]. Aggregates were tested for Fineness Modulus, Specific gravity, Water Absorption [5], Bulk density and Moisture content as per IS codes. Concrete was tested for Compressive strength under five cases as per M 25 mix design. In case-A, conventionally used Cement, Fine Aggregate, Coarse Aggregate and Water were mixed and analyzed for strength parameters. In case-B, fine aggregates was completely replaced by QDW and the other ingredients were the same as in case-A. In case-C, 50% fine aggregates and 50% QDW were used and the other ingredients were the same as in Case-A. In case-D, 75% fine aggregates and 25% QDW were used and the other ingredients were the same as in case-A. In case-E, 25% fine aggregates and 75% QDW were used and the other ingredients were the same as in case-A.

III. Mix design

As per the code IS: 10262 –1979 [8], the mix design is found and the amount of materials is calculated. According to the mix ratio, the amount of materials is given below, in Table I.

TABLE I. MIX PROPORTION

Water	Cement	Fine Aggregate	Coarse Aggregate
150	300	200	265
0.5	1	1.77	2.88

IV. Results and Discussion

The various results of tests done for cement are presented in Table II. All the parameters were observed to be within the permissible limits, though the initial setting time was found to be at a slightly upper level.

TABLE II. RESULTS OF TESTS DONE ON CEMENT

Type of tests	Results
Fineness	0.9%
Consistency	30.5%
Initial Setting Time	30 min
Final Setting Time	350 min
Specific Gravity	2.64

The results of tests done on aggregates are presented in Table III, and all the parameters were within the permissible limits.

TABLE III. RESULTS OF TESTS DONE ON AGGREGATES

Type of Tests	CA	FA	QDW
Specific Gravity (%)	2.72	2.65	2.56
Water Absorption (%)	0.5	1.0	.5

Bulk Density (kg/m^3)	1469.8	1460	1765
Fineness Modulus (%)	4.51	3.54	3.81
Moisture content (%)	1.90	1.50	Nil

The results of Compressive strength test on four cases are presented in Table IV**.** It was observed that concrete of all the five cases exhibited good compressive strength.

TABLE IV. RESULTS OF COMPRESSIVE STRENGTH ON CONCRETE

Type of Concrete	**Compressive strength of cubes, MPa**	
	7 days	**28 days**
Case-A	28.50	36.05
Case-B	27.32	37.98
Case-C	24.16	33.80
Case-D	26.81	26.04
Case-E	22.52	34.10

A graphical comparison of 7 day compressive strengths of all the five cases of mix designs is presented in figure 1. It can be observed that case-B exhibited a compressive strength of 27.32 MPa, which is close to the conventionally used case-A mix design. This is far better than the replacement of fine aggregate with 15% Ground Granulated Blast Furnace Slag which gave a 7 day compressive strength of 22.82 MPa [9]. Case-E obtained a compressive strength of 22.52 MPa which is similar to 10% replacement of Quarry dust [10] for 7days.

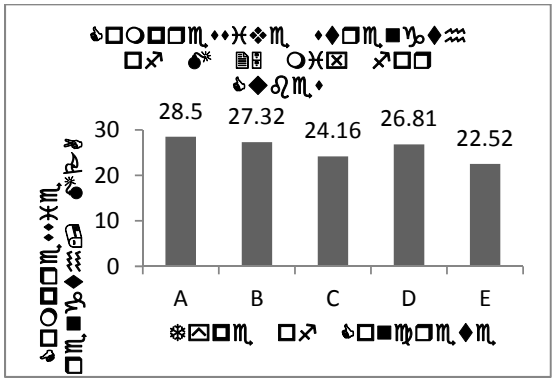

Figure 1. Compressive strength of 7 days for cube

Figure 2. depicts the 28 day compressive strengths of five cases of mix designs. In case-B which was replaced by QDW the 28 day compressive strength was observed to be 37.98 MPa which is quite a satisfactory value. This is very close to the replacement of fine aggregate with 20% Blast Furnace Slag which gave a 28 day compressive strength of 36.47 MPa [9]. Case-E obtained a compressive strength of 34.10 MPa for 28 days which is similar to 10% replacement of Quarry dust [10] for 27 days.

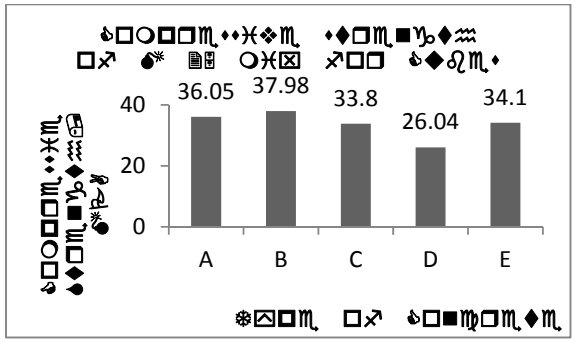

Figure 2. Compressive strength of 28 days for cube

V. Conclusion

The following conclusions were drawn from the experimental investigation.

1. A maximum compressive strength of 37.98 MPa was obtained with 100% replacement of QDW for 28 days.

2. It was observed that 100% replacement of QDW gave a satisfactory result when compared with conventional concrete for 7 days.

3. From this test, replacement of fine aggregate with QDW gave a compressive strength of 50% and 75% replacement respectively.

4. Partial replacement of FA with QDW showed encouraging results in terms of compressive strength.

5. Environmental wastes which pose a difficult problem in its disposal can be efficiently addressed through the results of this research.

VI. Reference

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