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Strength Improvement of M50 grade concrete as a partial replacement of fine aggregate with Stone Crusher Dust.

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Abstract

Concrete is used widely in all types of constructions ranging from small buildings to large structures like dams or reservoirs. It is the most widely used construction material to improve the strength& quality of structural elements. Sand is one of the important ingredients in the making of concrete but the availability of sand is a tedious task. For the protection of environment, almost all local governments have to be taken a decision to minimize sand excavation for utilization in construction. The current study an attempt has been made to studying the behavior of the concrete made by partial replacement of sand with Stone Crusher Dust (SCD) using admixture. The design mix prepared for M53 grade concrete as per IS Code and fine aggregate has been replaced by Stone Crusher Dust at 10%, 20%, 30%, 40% and 50% by weight. The strength tests have been made to study for 3, 7 and 28days curing period.

Key words

Compressive strength

Sand Crusher Dust (SCD)

Admixture

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1. Introduction

In earlier days the Egyptians, Romans were used early forms of concrete. In 1836 the first compressive and tensile strength took place in Germany to get resistance ability of compression and tension forces. But in present days the concrete made as very decorative. Cement, sand, coarse aggregate and water are the main ingredients in concrete to make any structure strong and durable. Emission of Co_2 in the manufacturing of cement and extraction of sand will cause global warming. Scientists, researchers, and industries are aware of this problem and trying to find out alternative methods. From previous studies, one of the solutions came forward to replace

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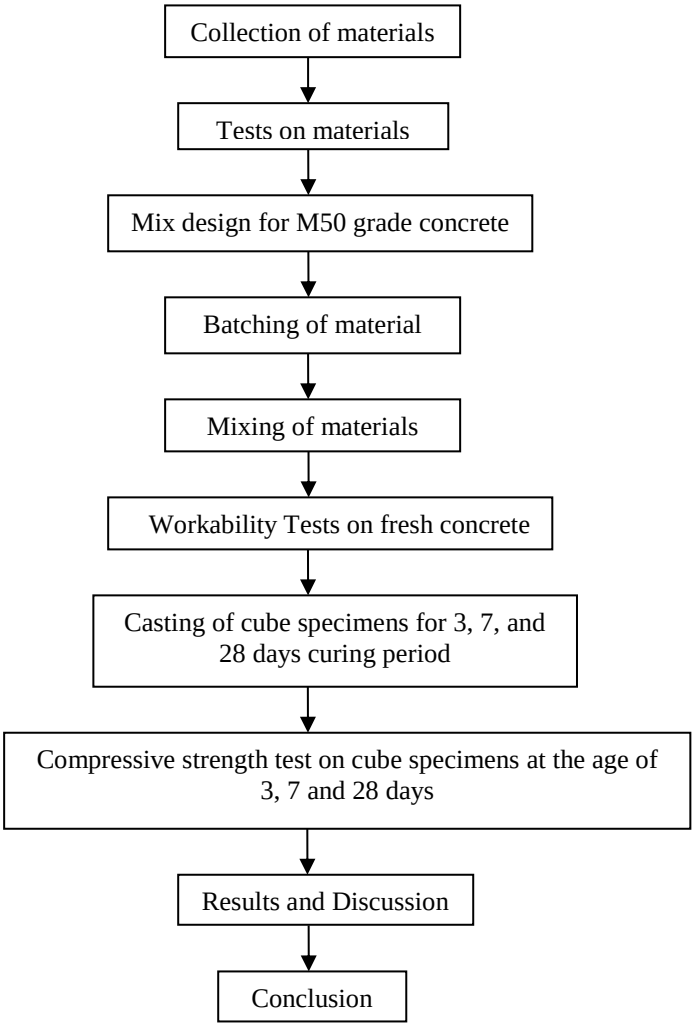
the cement with Fly ash and GGBS proved that these are considerable alternative replacement materials in the manufacturing of cement. Stone crushed dust can define as residue material without any silt after the extraction and processing of rocks to form fine particles. Crushed rock aggregate quarrying generates considerable volumes of quarry fines, often termed "quarry dust". So it is proposed to study the possibility of replacing sand with locally available stone crusher dust

Objectives of the work

To evaluate the compressive strength of concrete by partial replacement of sand with Stone Crushed Dust at which the concrete achieve more strength.

2. Methodology

The materials required for the concrete mix were collected from different sources and tested to know the properties of materials. In the present study, M50 grade of concrete mix was done as per IS 10262-2009 with maintaining constant water-cement ratio 0.40 by replacement of fine aggregate with stone crushed dust at different percentages. Based on the design mix, the concrete mix is prepared, slump cone test and compaction factor test was conducted on fresh concrete for knowing workability of concrete. The cube Specimens of 150mm X 150mm X 150mm for compressive strength were casted. After curing period of 3, 7, and 28 days the compressive strength of cubes tested by Compression Testing Machine (CTM).The following flow chart gives a clear picture of methodology for the present work.



3. Materials

A. Cement

Ordinary Portland cement (OPC)53 grade conforming to IS 12269-2013 standards has been procuredand the following tests have been donein the laboratory for determining physical properties.

Table 1 Physical properties of Cement

Property	OPC 53
Fineness of the cement	93.60%
Specific Gravity	2.99
Initial setting time	35minutes
Final setting time	580minutes

ACC cement Branch conforming to ISI standards has been procuredfor Ordinary Portland cement (OPC) 53 grade, and following the below mentioned chemical properties.

Table 2 Chemical properties of cement

Chemical composition	Percentage
Al_2O_3	6.19
Fe_2O_3	2.45
Mgo	3.55
Cao	60.29
SiO_2	18.24
SO_3	2.38

B. Fine Aggregates (F.A)

Locally available river sand which is free from organic impurities is used. Sand passing through IS sieve 4.75mm and retaining on IS sieve 150µ is used in this investigation.

Table 3 Physical properties of F.A

Property	Specification
Specific Gravity	2.65
Grading	ZONE-II
Moisture content (%)	5

C. Coarse Aggregate (C.A)

The coarse aggregate used here with having maximum size is 20mm. As per IS 383:1970 the proportion of mix of coarse aggregate, with 60% of20mm size and 40% of10mm.

Table 4 Physical properties of C.A

Property	Specification
Fineness of modulus	3.0
Specific Gravity	2.80

D.Stone Crusher Dust

Stone Crusher Dust is by product generated from quarrying activities involved in the production of crushed coarse aggregate from crusher plant .In the present study available stone crusher dust collected from a crusher plant near by **yendada,visakhapatnam** is used so that sieve configuration gets matched with that of river sand for preparation of concrete mix. Stone Crushed Dust passing through 4.75mm sieve and retained on 75microns sieve has been used.For replacing fine aggregates with Stone Crushed dust shall comply with the requirements of IS 383:2013(Third revision).

Table 5 Physical properties of SCD

Property	Specification
Specific Gravity	2.56
Grading	ZONE-III

From the previous studies the following physical and chemical properties were consideredin thepresent study.

Table 6 Comparison between Physical properties of Stone Crusher Dust (SCD) and Natural Sand

Property	SCD	Natural Sand
Specific Gravity	2.54-2.60	2.6-2.75
Relative Density (kg/m^3)	1720-1810	1460
Absorption (%)	1.20-1.50	Nil
Moisture content (%)	Nil	1.50
Fine particle less than 0.075mm (%)	12-15	6
Sieve analysis	Zone-III	Zone-II

Table 7Comparison between Chemical compositions of Crusher Dust (SCD) and Natural Sand

Constituent	SCD (%)	Natural Sand (%)
SiO_2	62.48	80.78
Al_2O_3	18.72	10.52
Fe_2O_3	6.54	1.75
CaO	4.83	3.21
MgO	2.56	0.77
Na_2O	Nil	1.37
K_2O	3.18	1.23
TiO_2	1.21	Nil

E.Super Plasticizer

Sikament 300 is a high range water reducing admixture and it is used whenever high plasticity and increased early and ultimate strengths are required The superplasticizing action of Sikament 300 provides excellent workability at very low water cement ratio's.

4. Results and Discussion

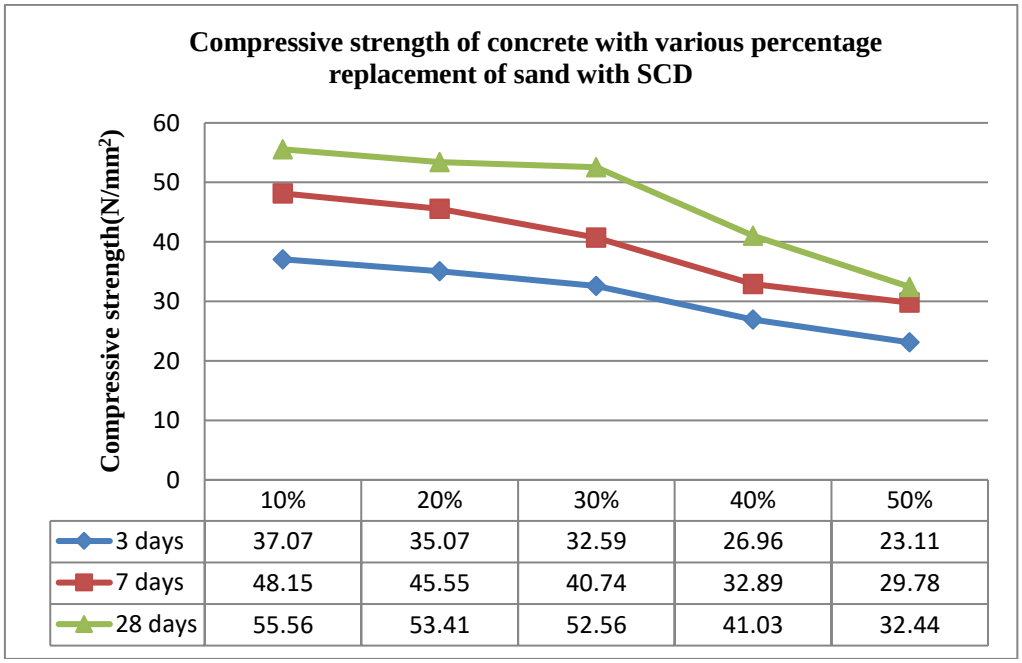
The cement of OPC 53 grade having specific gravity 2.99 used forM50Mix design and maintained water ccement ratio 0.45 in all the cases.The super plastisizer of 1.2% by weight of cement was added for better workability of concrete.The compressive strength test was carried out on 150mm x150mm x150mm size cubes,for 3, 7 and 28 days curing period as per IS: 516-1959. The workability and compressive strength test results were given below

Table 8Workability test results at various percentage replacement of sand with SCD

S. No.	Percentage replacement of SCD	Slump (mm)
1.	0%	85
2.	10%	90
3.	20%	85
4.	30%	80
5.	40%	70
6.	50%	65

Table 9Compressive strength test results at various percentage replacement of sand with SCD

Percentage replacement of SCD	Compressive strength(N/mm^2)		
	3days	7days	28days
Control specimen (no replacement of SCD)	33.18	46.37	53.93
10%	37.07	48.15	55.56
20%	35.07	45.55	53.41
30%	32.59	40.74	52.56
40%	26.96	32.89	41.03
50%	23.11	29.78	32.44



4. Discussion

1. The 3, 7 and 28 days compressive strength increased at a replacement of 10% and 20% of SCD and these strengths are good when compared to the control specimen.
2. The 28 days strength is almost same i.e. 53.21N/mm^{2}at 20% replacement of SCD but at further replacements like 20%, 30%, 40% and 50% the 3,7 and 28 days strengths were decreased.
3. The natural sand contains 80.78% Silica (Sio_2) but SCD contains 62.48%.
   Silica having spherical particles or microspheres of mean diameter about 0.15 microns, with a very high specific surface area. Each microsphere is smaller than an average cement grain. Higher the surface area causes higher the strength of concrete. Due to less content of Sio_2 in SCD, it gives less strength when compared to the utilization of sand in concrete.
4. The Al_2O_3 and Cao contentsare more in SCD but hydrated aluminates do not contribute anything to the strength of concrete. On the other hand, their presence is harmful to the durability of concrete, particularly where the concrete is attacked by sulphates. So the effect of chemicals on this concrete in the present study is recommended for analysis of durability.
5. At 10% replacement of SCD the concrete gave good workability but after that, the results were dropdown for a further increment of SCD.Because of its shape of particles in SCD it gives low workability when compared to natural sand. So increment of SCD in this concrete showed fewer workability results.

5. Conclusion

Based on this experimental investigation, it is found that upto 20% SCD can be considerable as an alternative replacement material to the natural sand in concrete. But an analysis is necessary on this concrete to avoid the attacks of chemicals will give the ultimate durability report.

References

1. IS 456-2000 (forth revision) code of practice Plain and Reinforced Concrete, Bureau of Indian standards, New Delhi.
2. IS 10262–2009 Concrete mix proportioning guidelines, Bureau of Indian standards, New Delhi.
3. IS 383–2013(Third revision) Specification for coarse and fine aggregate from natural sources for concrete, Bureau of Indian standards, New Delhi.
4. M.S. Shetty, *Concrete Technology Theory and Practice*, 5th edition, S.Chand & Co. Ltd., New Delhi
5. Sandeep Kumar Singh, Vikas Srivastava, V.C. Agarwal, Rakesh Kumar and P.K. Mehta have studied on An Experimental Investigation on Stone Dust as Partial Replacement of Fine Aggregate in Concrete in 2014 Journal of Academia and Industrial Research (JAIR) Volume 3, Issue 5 October 2014
6. Kujur, Franklin Eric. Srivastava, Vikas. Agarwal, V.C. Anjelo F. Denis and Ali, Ehsan (2014) Stone Dust as Partial Replacement of Fine Aggregate in Concrete, Journal of Academia and Industrial Research (JAIR) Volume 3, Issue 3.
7. K. Subramanian, A. Kannan have studied on An Experimental Study On Usage Of Quarry Dust As Partial Replacement For Sand In Concrete And Mortar in 2013 Australian Journal of Basic and Applied Sciences, 7(8): 955-967, 2013 ISSN 1991-8178
8. Ankit Nileshchandra Patel, Jayeshkumar Pitroda "Stone Waste in India for Concrete with Value Creation Opportunities". International Journal of Latest Trends in Engineering and Technology. Vol 2. Dated 2nd March 2013. ISSN 2278-621X.
9. Lakhan Nagpal, Arvind Dewangan, Sandeep Dhiman and Sumit Kumar "Evaluation of Strength Characteristics of Concrete Using Crushed Stone Dust as Fine Aggregate". International Journal of Innovative Technology and Exploring Engineering. Vol 2. Issue 6 May 2013. ISSN 2278-3075.
10. Dr. A. D. Pofale (Professor in Civil Engineering, viswaswarayya national Institute of Technology, Nagpur) is investigated on "Effective utilizationm of crusher dust in concrete using as replacement of fine aggregate", IJSARP journal, volume 3, in August 2013.
11. G.Balamurugan (Associate professor and head of the department of civil engineering, jayamata Engineering college, Aralvoimozhi) and Dr.P.Perumal (Principal, Mahendra Institute of Engineering and technology, Mallasamudram, Namakkal are investigated on "An experimental study on Use of stone Quarry dust to replace sand in concrete", IJSARP journal, volume 3, in December 2013.
12. Er.Lalit kumar (Civil dept. RPIIT KARNAL) And Er.Arvinder singh(Civil dept. RPIIT KARNAL) are investigated on "A Study On Strength Of Concrete Using crushed stone Dust as Fine Aggreagate", IJSARP journal, volume 3, in 2013.
13. Lohani, Padhi, Dash and Jena "Optimum utilization of Quarry dust as partial replacement of sand in concrete". International Journal of Applied and Engineering Research. Vol 1. Issue 2 2012. ISSN 2277-9442.
14. Nagabhushana rao (Department of Civil engineering, JSS academy of technical education) and H. Sharada bai (Department of Civil engineering, UVCE, Bangalore University are investigated on "Use of crushed rock powder as replacement of fine aggregate in motor and concrete", IJST journal, volume-4, no 8 in aug 2011
15. Radhikesh P. Nanda (Associate Professor, Department of Civil Engineering, NIT Durgapur, Durgapur), Amiya K. Das (PG student, Department of Civil Engineering, KIIT University, Bhubaneswar), Moharana.N.C (Assistant Professor, Department of Civil Engineering, KIIT University, Bhubaneswar) are invisigated on Stone crusher dust as a fine aggregate in Concrete for paving blocks INTERNATIONAL JOURNAL OF CIVIL AND STRUCTURAL ENGINEERING Volume 1,in 2010