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A Study On The Strength Of Concrete Using Crushed Stone Dust as Fine Aggregate

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Abstract -- The purpose of this study was to investigate the possibility of using crushed stone dust as fine aggregate partially or fully with different grades of concrete composites. The suitability of crushed stone dust waste as a fine aggregate for concrete has been assessed by comparing its basic properties with that of conventional concrete. Two basic mixes were chosen for natural sand to achieve M25 and M30 grade concrete. The equivalent mixes were obtained by replacing natural sand by stone dust partially and fully. The test results indicate the crushed stone dust waste can be used effectively to replace natural sand in concrete. In the experimental study of strength characteristics of concrete using crushed stone dust as fine aggregate it is found that there is increase in compressive strength, flexural strength and tensile strength of concrete.
Keywords – Cement, Fine Aggregate, Coarse Aggregate, Stone Dust, Water.

I. INTRODUCTION

The concrete is a composite material which is predominantly used all over the world. The strength characteristics of concrete depend upon the properties of constituent material and their combined action. Fine aggregate is one of the important constituent materials as far as strength characteristics of concrete are concerned. Increase in demand and decrease in natural sources of fine aggregate for the production of concrete has resulted in the need to identify news sources of fine aggregate. River and which is most commonly used as fine aggregate in the production of concrete and mortar poses the problem of acute shortage in many areas. At same time increasing quantity of crushed stone dust is available from crusher as waste. The disposal of this dust is serious environmental problem. If it is possible to use this crushed stone dust in making concrete and mortar by partial or full replacement of natural river sand then this will not only save the cost of construction but at the same time will solve the problem of disposal of this dust. Concrete made with this replacement can attain the same compressive strength comparable tensile strength and modulus of rupture. For satisfactory utilization of this alternatives material, the various phases of examination have to be technical feasibility, durability of processed concrete and economic feasibility. With the ongoing research being done to develop appropriate technology and field trail to monitor the performance and assessment of economic feasibility, the use of alternatives material will become more viable.

II. LITERATURE REVIEW

Nagraj T.S et.al (1996) reported that rock dust due to its higher surface area consumes more cement in comparison to sand which increases workability. He studied to effect of rock dust and pebble as aggregate in cement and concrete and found that crushed stone dust could be used to replace the natural sand in concrete. The mix design introduced by Nagaraj T.S reported that there are three possibilities of ensuring the workability namely combination of rock dust and sand, use of super plasticizers and change water content. Shukla et al. (1998**)** investigated the behavior of concrete made by partial or full replacement of river sand by crushed stone dust as fine aggregate and reported that 40 percent sand can be replaced by crushed stone dust without effecting the strength of concrete. Venugopal (1998) et al. examined the effect of rock dust as fine aggregate in cement and concrete mixes. They have suggested a method to proportion the concrete using rock dust as fine aggregate. A.K Sahu et al. (2003**)** investigated the basic properties of conventional concrete and concrete made using quarry dust have compared. They have studied M20 and M30 concretes. Equivalent mixes are obtained by replacing stone dust partially/fully. Test results indicate effective usage of stone dust with same compressive strength, comparable tensile strength and modulus of rupture. Workability of 40% replacement of stone dust with 2% Superplasticizer is equal to the workability of conventional concrete. Workability is increased by the addition of Superplasticizer.

III. MATERIALS AND METHODS

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A. Cement

Ordinary Portland cement of grade 43 was used for preparation of concrete mix. The quality of cement was checked through various tests and was compared with the specifications given in IS 811-21989 for ordinary Portland cement.

B. Fine Aggregate

Locally available river sand was used. The sand was cleaned from all inorganic impurities and passed through 10 mm size sieve and retained on 75 micron sieve.

C. Coarse Aggregate

Coarse aggregate available from nearby crusher is used. The aggregate was cleaned from all impurities and dust. The coarse aggregate passing through 10 mm sieve and retained on 600 micron sieve are mixed in proportion of 60:40 percent.

D. Stone Dust

Stone dust available from crusher plant at Ambala is used so that sieve configuration gets matched with that of river sand used for preparation of concrete mix. Stone dust passing through 4.75 mm sieve and retained 75 micron sieve has been used.

E. Water

Water used for mixing and curing was tap water free from injuries amounts of oil acids, alkyls salts organic matter or other substances that may be harmful to concrete as per clause 5.4 of IS 456-2000.

IV. EXPERMENTAL STUDY

The cubes were tested in compressing testing machine after 7 and 28 days with uniformly increasing static loading using 300 tons capacity compression testing machine. The loading was transmitted from loading machine to the specimen by rigid steel plates placed on both above and below specimen. The load was applied until needle started deflecting backward after crushing of the specimen and the last reading was noted. The beams were tested in a frame having capacity 100 tons with two point load test. the specimens were divided in three parts equally and two point load were kept at the end of middle third part of specimen and the load was applied through cylindrical iron piece below the dial gauge. The cylinders were tested in compression testing machine with uniformly increasing static loading using 300 tans capacity compression testing machine. The test consists of applying a compressive line load along the opposite generators of a concrete cylinder placed with its axis horizontal between the compressive platens. Due to the compression loading a fairly uniform tensile stress is develop over nearly 2/3of the loaded diameter as obtained an elastic analysis. The magnitude of this tensile stress (acting in a direction perpendicular to the line of action of applied loading) is given by the formula (IS: 5816-1970) =2P/IIDL = 0.673P/DL.

A. The cubes size 150mm for compressive strength.
B. The Beam size 500mm × 100mm × 100mm for flexural strength.
C. The cylinder size 150mm dia. and 300mm height for split tensile strength.
D. The details of cubes, beam and cylinders given below.

TABLE 1: Details of Specimen Designation

S.No.	Specimen Type	Grade of concrete	Specimen Label	Property tested	No. of specimen
1	Cube	M25	A1 - 0	7 days compressive strength	3
2	Cube	M25	A1 - 20	7 days compressive strength	3
3	Cube	M25	A1 - 50	7 days compressive strength	3
4	Cube	M25	A1 - 100	7 days compressive strength	3
5	Cube	M30	B1 - 0	7 days compressive strength	3
6	Cube	M30	B1 - 20	7 days compressive strength	3
7	Cube	M30	B1 - 50	7 days compressive strength	3
8	Cube	M30	B1 - 100	7 days compressive strength	3
9	Beam	M25	A2 - 0	7 days flexural strength	3

10	Beam	M25	A2 - 20	7 days flexural strength	3
11	Beam	M25	A2 - 50	7 days flexural strength	3
12	Beam	M25	A2 - 100	7 days flexural strength	3
13	Beam	M30	B2 - 0	7 days flexural strength	3
14	Beam	M30	B2 - 20	7 days flexural strength	3
15	Beam	M30	B2 - 50	7 days flexural strength	3
16	Beam	M30	B2 - 100	7 days flexural strength	3
17	Cube	M25	A3 - 0	28 days compressive strength	3
18	Cube	M25	A3 - 20	28 days compressive strength	3
19	Cube	M25	A3 - 50	28 days compressive strength	3
20	Cube	M25	A3 - 100	28 days compressive strength	3
21	Cube	M30	B3 - 0	28 days compressive strength	3
22	Cube	M30	B3 - 20	28 days compressive strength	3
23	Cube	M30	B3 - 50	28 days compressive strength	3
24	Cube	M30	B3 - 100	28 days compressive strength	3
25	Beam	M25	A4 - 0	28 days flexural strength	3
26	Beam	M25	A4 - 20	28 days flexural strength	3
27	Beam	M25	A4 - 50	28 days flexural strength	3
28	Beam	M25	A4 - 100	28 days flexural strength	3
29	Beam	M30	B4 - 0	28 days flexural strength	3
30	Beam	M30	B4 - 20	28 days flexural strength	3
31	Beam	M30	B4 - 50	28 days flexural strength	3
32	Beam	M30	B4 - 100	28 days flexural strength	3
33	Cylinder	M25	A5 - 0	28 days split tensile strength	3
34	Cylinder	M25	A5 - 20	28 days split tensile strength	3
35	Cylinder	M25	A5 - 50	28 days split tensile strength	3
36	Cylinder	M25	A5 - 100	28 days split tensile strength	3
37	Cylinder	M30	B5 - 0	28 days split tensile strength	3
38	Cylinder	M30	B5 - 20	28 days split tensile strength	3
39	Cylinder	M30	B5 - 50	28 days split tensile strength	3
40	Cylinder	M30	B5 - 100	28 days split tensile strength	3

V. RESULTS AND DISCUSSION

The present experimental study was undertaken to replace the fine aggregate in concrete with stone dust and to check the compressive strength, flexural strength and spilt tensile strength of concrete for M25 and M30 grade concrete. In the present work cubes, beams and cylinders were tested for different percentage of stone dust replacing fine aggregate in concrete for M25 and M30 grade concrete. In the experimental study stone dust, the cubes were tested for 7days and 28days compressive strength 0%, 20%, 50% and 100% replacement of fine aggregate by stone dust in M25 and M30 grade concrete. The 7 days and 28 days compressive strength is shown in tables 2 to 3 and 6 to 7 respectively. The 7 days and 28 days flexural strength beams obtained by replacing 0%, 20%, 50%, and 100% fine aggregate with stone dust is shown in tables 4 to 5 and 8 to 9 respectively. The result of cylinders that were tested for 28 days is shown tables 10 to 11. It has been observed that the results obtained in all compressive, flexural and spilt tensile strength are comparable with that of concrete with stone dust.

TABLE 2: 7 Days Compressive Strength of Concrete

S. No.	Sample No.	Load (Tones)	Area (Sq. mm)	Compressive Strength (Mpa)	Average Strength (Mpa)
1.	A1 - 0	57	22500	24.85	
2.	A2 - 0	59	22500	25.72	24.85
3.	A3 - 0	55	22500	23.98	
4.	A1 - 20	71	22500	30.96	
5.	A2 - 20	60	22500	26.16	28.2
6.	A3 - 20	63	22500	27.47	
7.	A1 - 50	60	22500	26.15	
8.	A2 - 50	68	22500	29.65	27.61
9.	A3 - 50	62	22500	27.03	
10.	A1 - 100	64	22500	27.9	
11.	A2 - 100	55	22500	23.98	26.16
12.	A3 - 100	61	22500	26.6	

TABLE 3: 7 Days Compressive Strength of Concrete

S. No.	Sample No.	Load (Tones)	Area (Sq. mm)	Compressive Strength (Mpa)	Average Strength (Mpa)
1.	B1 - 0	64	22500	27.9	
2.	B2 - 0	61	22500	26.6	28.05
3.	B3 - 0	68	22500	29.65	
4.	B1 - 20	78	22500	34	
5.	B2 - 20	64	22500	27.9	31.24
6.	B3 - 20	73	22500	31.83	
7.	B1 - 50	67	22500	29.21	
8.	B2 - 50	78	22500	34	31.53
9.	B3 - 50	72	22500	31.39	
10.	B1 - 100	70	22500	30.52	
11.	B2 - 100	67	22500	23.98	26.16
12.	B3 - 100	65	22500	26.6	

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TABLE 4: 7 Days Flexural Strength of Concrete

S. No.	Sample No.	Dial Gauge Reading	Load (Tones)	Flexural Strength (Mpa)	Average Strength (Mpa)
1.	A7 - 0	25	7.66	3.83	
2.	A8 - 0	26	7.97	3.99	4.14
3.	A9 - 0	30	9.2	4.6	
4.	A7 - 20	29	8.89	4.45	
5.	A8 - 20	30	9.2	4.6	4.55
6.	A9 - 20	30	9.2	4.6	
7.	A7 - 50	30	9.2	4.6	
8.	A8 - 50	30	9.2	4.6	4.6
9.	A9 - 50	30	9.2	4.6	
10.	A7 - 100	28	8.58	4.29	
11.	A8 - 100	29	8.89	4.45	4.34
12.	A9 - 100	28	8.58	4.29	

TABLE 5: 7 Days Flexural Strength of Concrete

S. No.	Sample No.	Dial Gauge Reading	Load (Tones)	Flexural Strength (Mpa)	Average Strength (Mpa)
1.	B7 - 0	27	8.28	4.14	
2.	B8 - 0	28	8.58	4.29	4.45
3.	B9 - 0	32	9.81	4.9	
4.	B7 - 20	32	9.81	4.9	
5.	B8 - 20	32	9.81	4.9	4.95
6.	B9 - 20	33	10.12	5.06	
7.	B7 - 50	32	9.81	4.9	
8.	B8 - 50	33	10.12	5.06	5
9.	B9 - 50	33	10.12	5.06	
10.	B7 - 100	31	9.5	4.75	
11.	B8 - 100	30	9.2	4.6	26.16
12.	B9 - 100	30	9.2	4.6	

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TABLE 6: 28 Days Compressive Strength of Concrete

S. No.	Sample No.	Load (Tones)	Area (Sq. mm)	Compressive Strength (Mpa)	Average Strength (Mpa)
1.	A4 - 0	97	22500	42.29	
2.	A5 - 0	83	22500	36.19	38.8
3.	A6 - 0	87	22500	37.93	
4.	A4 - 20	107	22500	46.65	
5.	A5 - 20	89	22500	38.8	42.14
6.	A6 - 20	94	22500	40.98	
7.	A4 - 50	93	22500	40.55	
8.	A5 - 50	98	22500	42.73	41.42
9.	A6 - 50	94	22500	40.98	.
10.	A4 - 100	101	22500	44.04	
11.	A5 - 100	78	22500	34	39.24
12.	A6 - 100	91	22500	39.68	

TABLE 7: 28 Days Compressive Strength of Concrete

S. No.	Sample No.	Load (Tones)	Area (Sq. mm)	Compressive Strength (Mpa)	Average Strength (Mpa)
1.	B4 - 0	100	22500	43.6	
2.	B5 - 0	100	22500	43.6	43.75
3.	B6 - 0	101	22500	44.04	
4.	B4 - 20	101	22500	44.04	
5.	B5 - 20	109	22500	47.52	46.22
6.	B6 - 20	108	22500	47.09	
7.	B4 - 50	111	22500	48.4	
8.	B5 - 50	109	22500	47.52	47.96
9.	B6 - 50	110	22500	47.96	
10.	B4 - 100	112	22500	48.83	
11.	B5 - 100	99	22500	43.16	45.34
12.	B6 - 100	101	22500	44.04	

TABLE 8: 28 Days Flexural Strength of Concrete

S. No.	Sample No.	Dial Gauge Reading	Load (Tones)	Flexural Strength (Mpa)	Average Strength (Mpa)
1.	A10 - 0	42	12.88	6.44	
2.	A11 - 0	45	13.8	6.9	6.85
3.	A12 - 0	47	14.41	7.2	
4.	A10 - 20	43	13.18	6.6	
5.	A11 - 20	44	13.5	6.75	6.75
6.	A12 - 20	45	13.8	6.9	
7.	A10 - 50	40	13.8	6.9	
8.	A11 - 50	45	13.8	6.9	6.9
9.	A12 - 50	45	13.8	6.9	
10.	A10 - 100	43	13.18	6.6	
11.	A11 - 100	43	13.18	6.6	6.55
12.	A12 - 100	42	12.88	6.44	

TABLE 9: 28 Days Flexural Strength of Concrete

S. No.	Sample No.	Dial Gauge Reading	Load (Tones)	Flexural Strength (Mpa)	Average Strength (Mpa)
1.	B10 - 0	43	13.18	6.6	
2.	B11 - 0	50	15.33	7.66	7.36
3.	B12 - 0	51	15.63	7.82	
4.	B10 - 20	42	12.88	6.44	
5.	B11 - 20	41	12.57	6.29	6.44
6.	B12 - 20	43	13.18	6.59	
7.	B10 - 50	47	14.4	7.21	
8.	B11 - 50	47	14.4	7.21	7.21
9.	B12 - 50	47	14.4	7.21	
10.	B10 - 100	46	14.1	7.05	
11.	B11 - 100	46	14.1	7.05	7
12.	B12 - 100	45	13.8	7	

TABLE 10: 28 Day Split Tensile Strength of Concrete

S. No.	Sample No.	Load (Tones)	Area (Sq. mm)	Split Tensile Strength (Mpa)	Average Strength (Mpa)
1.	A13 - 0	19	14137.17	2.64	
2.	A14 - 0	21	14137.17	2.91	2.73
3.	A15 - 0	19	14137.17	2.64	
4.	A13 - 20	22	14137.17	3.05	
5.	A14 - 20	21	14137.17	2.91	3
6.	A15 - 20	22	14137.17	3.05	
7.	A13 - 50	21	14137.17	2.91	
8.	A14 - 50	21	14137.17	2.91	2.96
9.	A15 - 50	22	14137.17	3.05	
10.	A13 - 100	20	14137.17	2.76	
11.	A14 - 100	20	14137.17	2.76	2.76
12.	A15 - 100	20	14137.17	2.76	

TABLE 11: 28 Day Split Tensile Strength of Concrete

S. No.	Sample No.	Load (Tones)	Area (Sq. mm)	Split Tensile Strength (Mpa)	Average Strength (Mpa)
1.	B13 - 0	23	14137.17	3.19	
2.	B14 - 0	24	14137.17	3.33	3.28
3.	B15 - 0	24	14137.17	3.33	
4.	B13 - 20	26	14137.17	3.61	
5.	B14 - 20	26	14137.17	3.61	3.61
6.	B15 - 20	26	14137.17	3.61	
7.	B13 - 50	26	14137.17	3.61	
8.	B14 - 50	25	14137.17	3.47	3.56
9.	B15 - 50	26	14137.17	3.61	
10.	B13 - 100	24	14137.17	3.33	
11.	B14 - 100	24	14137.17	3.33	3.33
12.	B15 - 100	24	14137.17	3.33	

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VI. CONCLUSIONS

The following conclusion was drawn from the above experimental study:

A. The compressive strength, flexural strength and split tensile strength of concrete for grade M25 and M30 with stone dust as fine aggregate were found to be comparable with the concrete made with the river bed sand.
B. The increase in compressive strength of concrete with 20% replacement and 50% replacement of fine aggregate with stone dust is found to be 8 to 10%.
C. Stone dust can effectively be used in plain cement concrete in place of fine aggregate.
D. Non- availability of sand at reasonable costs as fine aggregate in cement concrete for various reasons, search for alternative material stone crusher (quarry) dust qualifies itself as a suitable substitute for sand at very low cost.
E. Crushed stone dust is free from chemical impurities such as sulphates and chlorides which improves the properties of concrete like strength and durability.
F. Effective utilization of quarry dust in concrete can save the waste of quarry works; and also produces a 'greener' concrete.

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REFERENCES

[1] Ilangovan. R, Mahendran. N, Nagamani. K, (2008), "Strength and durability properties of concrete containing quarry rock dust as fine aggregate", ARPN Journal of Engineering and applied science, Vol. 3, October.
[2] Nagaraj. T.S and Zahida Banu, (1996) "Efficient utilization of rocks dust and pebbles as aggregate in Portland cement concrete", The Indian concrete journal, Vol 70, No.1, PP14.
[3] Babu, K.K., (1996) "performance of quarry waste as fine aggregate in concrete", International seminar on civil engineering practice in twenty first century, Rookee, pp 926934.
[4] Shukla M, Shau A.K and Sachan A.K., (1998) "Performance of stone dust as fine aggregate in Portland replacing Sand on concrete and mortar", National seminar on advances in special concretes, Indian concrete institute, banglore, India, pp 241248.
[5] Pofale A.D and Kulkarni S.S., (1998) "comparative study of strength properties of concrete mixes with natural sand replaced fully or partiality by crushed stone powder (Basalt) from aggregate crushing plant waste", National seminar on advances in special concretes, Indian concrete institute, Banglore, India, pp 227240.
[6] Venugoal S. and Nagaraj T.S., (1999) "Cement concrete mixes with rock dust as fine aggregate Analysis and methodology", proceeding of the fifth international conference on concrete technology for developing countries, NCB New delhi, India, pp i3 – 12.
[7] A.K. Shau, Sunil Kumar and A.K. Sachan (2003) "crushed stone waste as fine aggregate for concrete" the Indian concrete journal, pp 845848.
[8] C. Narasimhan, B.T. Patil and Sankar H. Sanni (1999), "Performance of concrete with Quarry Dust as fine aggregate – An experimental Study", CE and CR journal, Vol. 12, No 9, pp 1924.
[9] Malhotra, V.M., Carette, G.G., (1985), "Performance of concrete incorporating lime stone dust as partial replacement for sand", ACI Journal, May-June, pp. 363-371.
[10] Manasseh, S., (2010), "Use of Crushed Granite Fine as Replacement to River Sand in Concrete Production", JOEL,Civil Engineering Department University of Agriculture P.M.B. 2373, Makurdi, Benue State, Nigeria.
[11] Misra R.N., (1984), "Use of stone dust from crushers in cement-sand mortars", The Indian Concrete Journal, August, pp. 219-224.
[12] Nadgir. N.S., Bhavikatti. S.S., (2007), "Stone quarry dust – An alternative for sand in concrete", Second national conference on materials and structural, December.
[13] Prakash Rao, D.S. & Giridhar Kumar, V. (2004), ''Investigations on concrete with stone crusher dust as fine aggregate'', The Indian Concrete Journal, M.E thesis submitted to Osmania University, Hyderabad, India.