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AN EXPERIMENTAL STUDY ON THE STRENGTH CHARACTERISTICS 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 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 result indicate that crushed stone dust waste can be used effectively used 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.

1. 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 characteristic of concrete is concerned. Increase in demand and decrease in natural sources of fine aggregate for the production of concrete has resulted in the need to identify new sources of fine aggregate. River sand 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 the same time increasing quantity of crushed stone dust is available from crushers as waste. The disposal of this dust is a 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 alternative 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 trials to monitor the performance and assessment of economic feasibility, the use of this alternative material will become more viable.

2. CONSTITUENT MATERIALS USED
The constituent materials used are cement, fine aggregate, coarse aggregate, stone dust and water. The recommended materials have been described below.

Cement
Various types of cement can be used in concrete with stone dust. The cement should be fresh, free from foreign matters and of uniform consistency. Usually ordinary Portland cement is used in normal conditions.

Fine Aggregate
The most common fine aggregate used in concrete is sand. The sand should be clean, hard, strong and free from organic impurities and deleterious substances. It should be capable of producing a sufficiently workable mix with a minimum water-cement ratio.

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Coarse Aggregate

The aggregates are formed due to natural disintegration of rocks or by artificial crushing of the rock or gravels. The properties of coarse aggregate are chemical and mineral composition, spectrographic description, specific gravity, hardness, strength, physical and chemical stability, pore structure and color. Some other properties of the aggregate not possessed by the parent rocks are particle size and shape, surface texture and absorption etc. All these properties may have a considerable effect on the quality of concrete in fresh and hardened states.

Stone Dust

Stone dust is obtained at crusher plants where the artificial crushing of the rock or gravels is done to obtain coarse aggregate. So the chemical comDo5ition of stone dust will be same as that of the coarse aggregate obtained from therein. Stone dust used for concrete should posses comparable fineness modulus as that of fine aggregate which is used in making concrete so that it will not absorb too much water from concrete or workability of concrete can be maintained.

Water

Mixing water should be fresh, clean and potable. Water should be free from impurities like clay, loam, soluble salts which lead to deterioration in the properties of concrete. Potable water is fit for mixing or curing of concrete.

Admixture

Generally admixtures are used to alter or improve the properties of cement concrete. Commonly used admixtures are.

I. Water reducing admixtures
II. Retarding admixtures
III. Water reducing and accelerating admixtures.

Addition of admixtures is recommended to increase workability of concrete. However it is recommended that prior testing of any admixture should be carried out before use.

3. CASTING OF TEST SPECIMENS

In the present study, 48 cubes, 48 beams and 24 cylinders were cast 24 cubes, 24 beams and 12 cylinders were of M25 grade of concrete and 24 cubes, 24 beams, and 12 cylinders were of M30 grade of concrete. Out of 24, 6 cubes and beams were cast for each 0, 20, 50 and 100 percentage of stone dust replacing river sand for each grade of concrete and out of 12, 3 cylinders were cast for each 0, 20, 50 and 100 percentage of stone dust replacing river sand for each grade of concrete.

The sizes of cubes were 150mm x 150mm x 150mm, the sizes of beam were 500mm x 100mm xl00mm and the size of cylinders was 150mm diameter and 300mm in height.

4. NOMENCLATURE OF TEST SPECIMENS

Mix M25 is represented by A and mix M30 by B. Suffix 1 to 3 and 4 to 6 were used for cubes that were tested in compression for 7 days and 28 days respectively. Suffix 7 to 9 and 10 to 12 were used for beams that were tested in flexure for 7 days and 28 days respectively and suffix 13 to 15 were used for cylinders that were tested for split tensile strength at 28 days.

0, 20, 50 and 100 represents the percentage of stone dust that replaced the river sand. For example A1-0 represents cubes of M25 grade of concrete that were tested for 7 days compressive strength having 0 percent of stone dust replacing river sand in concrete mix. B10-20 represents beams of M30 grade of concrete that were tested for 28 days flexural strength having 20 percent of stone dust replacing river sand in concrete mix

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5. EXPERIMENTAL SETUP

Specimens A1-0, A2-0, A3-0, A1-20, A2-20, A3-20, A1-50, A2-50, A3-50, A1 100, A2-100, A3-100 were tested for 7 days compressive strength of concrete in compression testing machine. Specimens A4-0, A5-0, A60, A420, A5-20, A6-20, A4-50, A5-50, A6-50, A4-100, A5-100, A6-100 were tested for 28 days compressive strength of concrete in compression testing machine. Specimens A7-0, A8-0, A9-0, A7- 20, A8-20, A9-20, A7-50, A8-50, A9-50, A7-100, A8-100, A9-100 were tested for 7 days flexural strength of concrete by three point load test. Specimen A10-0, A11-0, A12-0, AlO-20, Al 1-20, A12-20, Al0-50, A1l-50, A12-50, A10-100, Al 1-100, A12-100 were tested or 28 days flexural strength of concrete by three point load test. Specimen A13-0, A14-0, A15-0, A13-20, A14-20, A15-20, A13-50, A14-50, A15-50, Al3-100, Al4-100, Al 5-100 were tested for split tensile strength of concrete in compression testing machine The specimens were cured for 7 days and 28 days in a tank fully filled with water.

6. TESTING OF SPECIMENS

The cubes were tested in compression testing machine after 7 and 28 days with uniformly increasing static loading using 300 ton capacity compression testing machine. The loading was transmitted from loading machine to the specimen by rigid steel plates placed on both above and below the 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 of 100 ton with two point load test The specimens were divided in three parts equally and two point loads were kept at the end of middle third part of specimen and the load was applied through cylindrical iron piece kept below the dial gauge.

The cylinders were tested in compression testing machine with uniformly increasing static loading using 300 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

7. RESULT ANAYLSIS

7 Days Compressive Strength of Concrete

Sample No.	Load (Tones)	Area (mm^2)	Compressive strength (MPa)	Average strength (MPa)
A 1-0	**57.00**	**22500**	**24.85**	
A 2-0	**59.00**	**22500**	**25.72**	**24.85**
A 3-0	**55.00**	**22500**	**23.98**	
A 1-20	**71.00**	**22500**	**30.96**	
A 2-20	**60.00**	**22500**	**26.16**	**28.20**
A 3-20	**63.00**	**22500**	**27.47**	
A 1-50	**60.00**	**22500**	**26.15**	
A 2-50	**68.00**	**22500**	**29.65**	
A 3-50	**62.00**	**22500**	**27.03**	
A 1-100	**64.00**	**22500**	**27.90**	
A 2-100	**55.00**	**22500**	**23.98**	**26.16**
A 3-100	**61.00**	**22500**	**26.60**	

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7 Days Flexural Strength of Concrete

Sample No.	Dial Gauge Reading	Load (KN)	Modulus of Rupture (MPa)	Average Modulus of Rupture (MPa)
A 7-0	25	7.66	3.83	
A 8-0	26	7.97	3.99	4.14
A 9-0	30	9.20	4.60	
A 7-20	29	8.89	4.45	
A 8-20	30	9.20	4.60	4.55
A 9-20	30	9.20	4.60	
A 7-50	30	9.20	4.60	
A 8-50	30	9.20	4.60	4.60
A 9-50	30	9.20	4.60	
A 7-100	28	8.58	4.29	
A 8-100	29	8.89	4.45	4.34
A 9-100	28	8.85	4.29	

28 Days Flexural Strength of Concrete

Sample No.	Dial Gauge Reading	Load (KN)	Modulus of Rupture (MPa)	Average Modulus of Rupture (MPa)
A 10-0	42	12.88	6.44	
A 11-0	45	13.80	6.90	6.85
A 12-0	47	14.41	7.20	
A 10-20	43	13.18	6.60	
A 11-20	44	13.50	6.75	6.75
A 12-20	45	13.80	6.90	
A 10-50	40	13.80	6.90	
A 11-50	45	13.80	6.90	6.90
A 12-50	45	13.80	6.90	
A 10-100	43	13.18	6.60	
A 11-100	43	13.18	6.60	6.55
A 12-100	42	12.88	6.44	

28 Days Split Tensile Strength of Concrete

Sample No.	Load (Tones)	Area (mm^2)	Compressive strength (MPa)	Average strength (MPa)
A 13-0	19	14137.17	2.64	
A 14-0	21	14137.17	2.91	2.73
A 15-0	19	14137.17	2.64	
A 13-20	22	14137.17	3.05	
A 14-20	21	14137.17	2.91	3.00
A 15-20	22	14137.17	3.05	

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A 13-50	**21**	**14137.17**	**2.91**	
A 14-50	**21**	**14137.17**	**2.91**	**2.96**
A 15-50	**22**	**14137.17**	**3.05**	
A 13-100	**20**	**14137.17**	**2.76**	
A 14-100	**20**	**14137.17**	**2.76**	**2.76**
A 15-100	**20**	**14137.17**	**2.76**	

8. DISCUSSION OF RESULTS

In the experimental study of stone dust, the cubes were tested for 7 days and 28 days compressive strength with 0 %, 20 %, 50 % and 100 % replacement of fine aggregate by stone dust in M-25 and M-30 grade of concrete. The 7 days and 28 days compressive strength is shown in tables 4.2 to 4.3 and 4.6 to 4.7 respectively. The 7 days and 28 days flexural strength of beams obtained by replacing 0 %, 20 %, 50% and 100 % fine aggregate with stone dust is shown in tables respectively.

9. CONCLUSIONS

The following conclusions were drawn from the present experimental study

1) 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 river bed sand.
2) 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 %.
3) ‘Stone dust can effectively be used in plain cement concrete in place of fine aggregate.

10. SCOPE FOR FUTURE STUDIES

1) Use of admixtures to add to workability of concrete made with stone dust can be studied.
2) Durability aspects of concrete made with stone dust as fine aggregate can be Investigated.

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