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A Study on Effective use of Stone Dust in Partial Replacement with Cement

Jyotisman Saikia[1], Prem Narayan Tamuly[2], Pankaj Pratim Deuri[3], Rashmi Rekha Gohain[4], Partha Pratim Das[5] and Himanku Kr. Kalita[6]

[1,2,3,4,5,6]Royal Group of Institutions
E-mail: [1]jyotisman1912@gmail.com, [2]premnarayantamuly@gmail.com, [3]punkdeuri@gmail.com, [4]rgohain.2503@gmail.com, [5]parthababu@gmail.com, [6]himanku2010@gmail.com

Abstract—*Stone dust is a byproduct of stone crushing units which are generated in huge amounts every year which adversely affects the environment and substantially cause health hazards to the community belonging to the work place. So, we have to minimize this byproduct (stone dust) by using it for some other effective purpose. In view of the above discussion, an attempt is made to partially replace the stone dust with cement. The present investigation was taken up for determining the degree of suitability for the above said replacement in view to acquire the compressive strength results of concrete for every combinations of replacement viz., M1 (100% cement-0% stone dust), M2 (90% cement-10% stone dust), M3 (80% cement-20% stone dust), M4 (70% cement-30% stone dust) and M5 (60% cement-40% stone dust) keeping the weight of other quantities viz., sand, coarse aggregates (inclusive of 60%-20mm aggregates and 40%-10mm aggregates) same and to analyze the change of rates of materials with addition of stone dust. Mix Design is adopted as per IS: 10262-1982 for M20. From the compressive strength tests of concrete prepared in 30 cubes of size 15x15x15 cm we had found the highest compressive strength of the concrete made of combination M2 (90% cement-10% stone dust). By analyzing the rate we had infer that total cost of materials for making concrete gradually reduces with increasing amount of stone dust. Therefore it can be recommended and concluded that if we replace cement by 10% stone dust, we get the highest compressive strength of the concrete prepared which will be more economical than using 100% cement.*

1. INTRODUCTION

Stone dust which is released directly into the environment can cause environmental pollution. To reduce the impact of stone dust on environment and human, this waste can be used to produce new products or can be used as admixture in concrete so that the natural resources are used efficiently and hence environmental waste can be reduced. During the production of cement CO_2 is produced which cause global warming. By reducing cement consumption environment can be protected. An attempt was made to partially replace the cement with waste material stone dust with an aim not to lose the strength far from original concrete mix.

Here Stone dust is used for partial replacement with cement in concrete for studying the strength property of concrete and analyzing the rates of building materials (concrete as a whole) per 6 cubes made of size 15x15x15 cm. M20 grade concrete is used in the experiment by partially replacing cement with 0%, 10%, 20%, 30%, 40% stone dust successively.

2. MATERIALS

2.1. Stone Dust: Stone dust is collected from local stone crushing units of Boragaon Quarry, Pamohi, Guwahati, Assam. Specific gravity is observed to be 2.5 and water absorption of 3.33% is observed after testing it in laboratory.

2.2. Fine aggregates: They are bought from a dealer but the sand is from Chaygaon, Assam. It confirms to Zone-IV having fineness modulus 1.38, specific gravity of 2.45 and water absorption value of 1.14%.

2.3. Coarse aggregates: They are from the same crushing plant from where the stone dust is brought. It has a specific gravity of 2.37 and water absorption value of 5.42%.

2.4. Cement: Max cement is used for the project (Portland pozzolana cement) assuming the specific gravity to be 3.15.

2.5. Water: Tap water available in the laboratory was used for mixing and curing concrete.

3. EXPERIMENTAL TEST SET UP

The test for conducting compressive strength was done for M20 concrete with total 30cubes of size 150x150x150mm. Those 30 cubes are divided into 5 groups each group having 6 cubes. Those 6 cubes are again divided into 2 groups (3 cubes for 7days compressive strength and 3 cubes for 28days compressive strength) and we took the average compressive strength of concrete blocks in those 3 cubes. In every 6 cubes we have successively increased the amount of stone dust by 0%, 10%, 20%, 30%, and 40% with total weight of cement.

4. MIX DESIGN PROCEDURE

Concrete mix design as per IS: 10262-1982 is used in our experiment to determine various quantities of water, cement, sand, coarse aggregate to be used. Water cement ratio is assumed to be 0.5. The amount of materials required for 1 cubic meter of concrete by mix design are found out. Then amount of materials required per 6 cubes are subsequently found out.

5. RESULTS

5.1. Compressive strength results:

Table 1: 7days and 28days compressive strength

	7 DAYS strength in N/mm²			28 DAYS strength in N/mm²		
M1	17.78	17.33	17.78	27.55	26.66	27.11
M2	18.67	17.78	20.00	29.33	27.11	30.66
M3	16.00	14.22	16.00	24.44	21.33	24.00
M4	12.89	12.00	11.55	19.55	18.22	17.77
M5	10.22	10.67	10.67	15.55	16.88	16.44

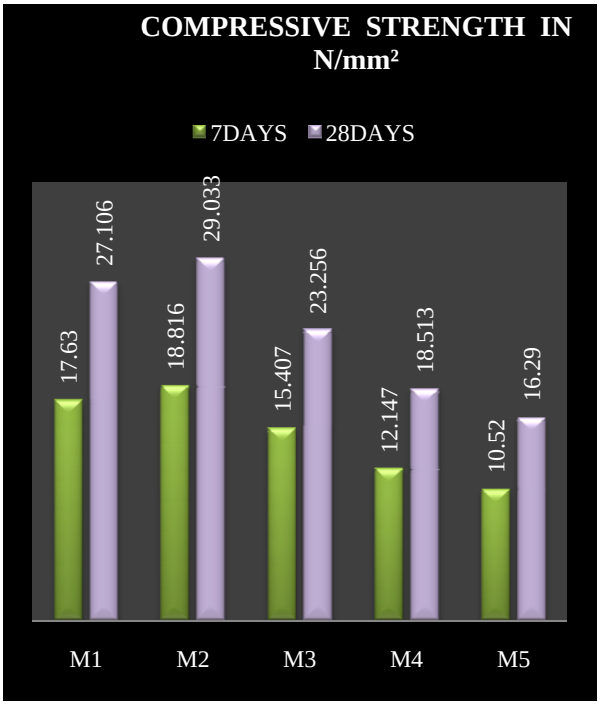

Fig 1: Average compressive strength

5.2. Cost Effectiveness:

Table 2: Rates of materials per 6 cubes in Rs.

	Cement	Stone Dust	Coarse aggregates (10mm & 20mm)	Sand	Total
M1	54.20/-	0.00/-	17.10/-	4.50/-	75.80/-
M2	48.80/-	0.45/-	17.10/-	4.50/-	70.85/-
M3	43.40/-	0.90/-	17.10/-	4.50/-	65.90/-
M4	38.00/-	1.35/-	17.10/-	4.50/-	60.95/-
M5	32.50/-	1.80/-	17.10/-	4.50/-	55.90/-

6. CONCLUSION

Compressive strength (7days and 28days) tends to increase from combination M1 to M2 and it results in further decrease thereafter to M5 prevailing least strength.

From the compressive strength tests for 7days and 28days, we had observed that the best compressive strength was in M2 or 2nd case i.e., 90% cement and 10% stone dust. Rate analysis for various sets of experiments have been found out from which we infer that the cost of construction decreases with increase in amount of stone dust applied and decrease in amount of cement since cement is more costlier than stone dust according to standard rates prevailing.

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