Partial Use of Stone Dust in Concrete as an Alternative of Sand

Mr. Yogesh Kumar Agarwal[1], Mr. Pradeep Kumar Jain[2], Mr. Jitesh Kumar Jain[3], Mr. Akhil Kumar Maheshwari[4]

[1]*Assistant Professor, Department of Civil Engineering, Jaipur Engineering College & Research Centre, Jaipur, Rajasthan, India*

[2]*Assistant Professor, Department of Civil Engineering, Jaipur Engineering College & Research Centre, Jaipur, Rajasthan, India*

[3] *Assistant Professor, Department of Civil Engineering, Jaipur Engineering College & Research Centre, Jaipur, Rajasthan, India*

[4]*Assistant Professor, Department of Civil Engineering, Jaipur Engineering College & Research Centre, Jaipur, Rajasthan, India*

ABSTRACT

Stone dust produced from stone crushing zones appears as a problem for effective disposal. Sand is a widely used fine aggregate used in construction work. In this research, the main concern is to find a substitute of sand. Substitution of normal sand by stone dust will serve both solid waste minimization and waste recovery. The research focuses to determine the relative performance of concrete by using stone dust. Water demand of crusher dust is high. A high dose of super plasticizer is required to achieve the preferred workability. Crusher stone dusts satisfy the parameters of Indian Standard code as fine aggregate. The concrete prepared using the dust successfully achieves the desired workability and strength. Since high dose of plasticizer is required the cost of overall concrete increases by 5%-8%. Proper quality control is required to use it at site.

Key words: Stone dust, concrete, compressive strength.

1. INTRODUCTION:

Nowadays, natural resources are depleting at a faster rate and on the other hand the industrial wastes are accumulating in the environment. A better approach to solve the both the problem is to use the industrial waste as replacement of natural resources. Concrete is the second most widely used material around the globe next to water and the most widely used material in construction industry due to its various properties. The use of concrete has increased exponentially and it has been estimated that around 25 billion tonnes of concrete is manufactured globally. With increasingproduction of concrete the raw materials required for it has also increased. In earlier days there used to be plenty of natural resources thus were used for the production of concrete like coarse aggregate and fine aggregate. But with increasing requirement the depletion of natural resources increased more rapidly, hence civil engineers started looking for different alternatives to use in construction. Also, conventional materials like natural soils, broken rock pieces, sand are popularly used in the construction of structures like roads, embankments, reclamation of grounds etc. Procurement of such materials in huge quantities have been becoming very difficult and presence of plastic fines in the soils causes surplus deformations which proves to be costly for the maintenance of structures. River sand is the most commonly used fine aggregate in the production of concrete poses the problem of acute shortage many areas. Crusher stone dust can be an economic alternative to the river sand. Crusher stone dust is produced during crushing of stones

into aggregates of desired size say 10mm, 20mm etc. These dusts are generally used in making blocks or land filling. It has potential to be used as partial replacement of natural river sand in concrete. Use of stone dust in concrete not only improves the quality of concrete but also conserve the natural river sand for future generations. These resources of engineering materials (sand, stone) are limited and day by day the dependency on them must be minimized. So some other materials should be introduced by replacing sand and stone. Stone dust is one of such alternative of sand that can fulfill the demand of fine aggregate.

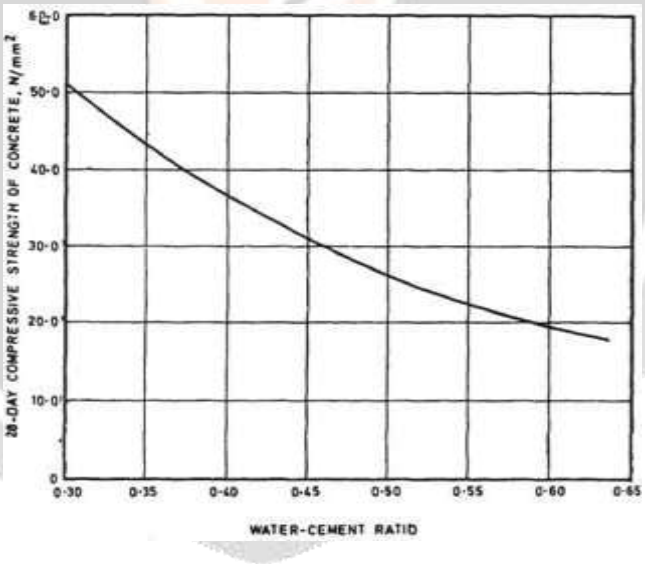
2. METHODOLOGY:

In order to establish the stone powder produced during stone crushing as an substitute of normal sand a lots of laboratory test are conducted and compared with the same obtained result from the normal sand concrete.

3. COMPRESSIVE STRENGTH:

The compressive strength of concrete depends on the water cement ratio lower be the water cement ratio higher be the strength and vice-versa. The test is performed on cubes which are casted using the concrete and are cured in the curing tank. Cubes are test at 7 days and 28 days. Each time 3 cubes are tested and the strength is represented as average of the three. So in general 6 cubes are casted to test the compressive strength of concrete.

In India the test is performed as per IS 516:1959 which defines the procedure for the complete test including sampling, casting, curing and testing. The size of cubes is 150*150*150 mm. For casting of the cubes iron moulds are used and compaction is done. These casted cubes are then stored for curing in curing tank after remolding and is finally tested using Compression Testing Machine (CTM) which shows the load bearing capacity or failure load for the cube.



Variation of compressive strength v/s water cement ratio

4. WORKABILITY:

It is defined as the virtual ease with which concrete can be mixed, transported, moulded and compacted. The degree of workability required depends on three factors. These are the size of the section to be concreted, the amount of reinforcement, and the method of compaction to be used.

There are three ways to measure the workability of a fresh concrete

(i). Slump Cone Test

(ii). Compaction Factor Test (iii). Flow Table Test

A slump test is a method used to determine the consistency of concrete. The consistency, or stiffness, indicates how much water has been used in the mix. The stiffness of the concrete mix should be matched to the requirements for the finished product quality. The concrete slump test is used for the measurement of a property of fresh concrete. The test is an empirical test that measures the workability of fresh concrete. More specifically, it measures consistency between batches. The test is popular due to the simplicity of apparatus used and simple procedure. The IS 1199:2000 specifies the procedure for the test which has been followed for this test .

With this observation, there is need to adjust the workability so that the required workability can be achieved. There is different approach to improve the workability. The following approaches have been tried to improve the workability and their limitations are mentioned below:

(i) Increase water content of concrete

(ii) Partial replacement of sand (iii)Use higher water cement ratio
(iv) Use of super plasticizers

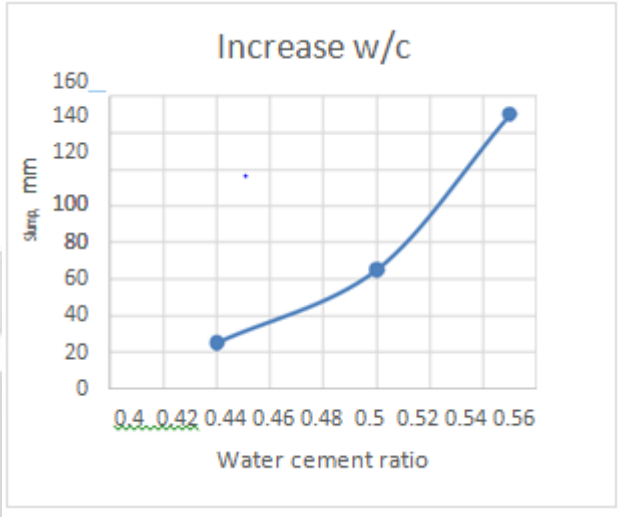
(i) Increase water content of concrete:

Workability depends on water, with increase in water content workability increases

(ii) Partial replacement of sand: The partial solution of sand may lead to manual error at site in mixing and weighing and also it need lots of trial to obtain the optimum level of replacement.

(iii) Use higher water cement ratio:

Another approach is to increase the water cement ratio this will increase the water content of the concrete. It can be observed from the above graph that the slump increase with increase in the water cement ratio. Three trials have been done for M25 OPC at w/c 0.44, 0.5 and 0.55 and the corresponding slump values are 25mm, 65mm and 150mm respectively

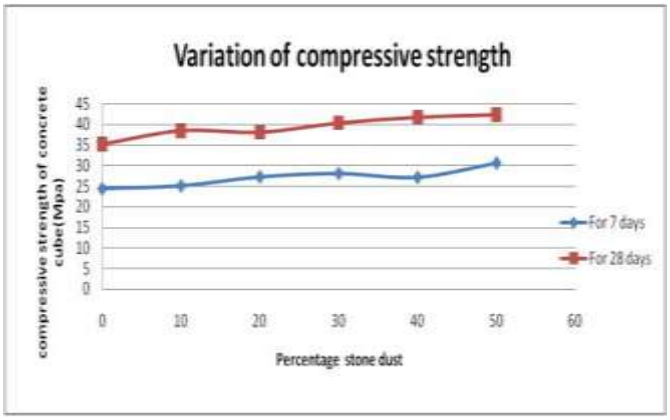


(iv) Use of Super Plasticizers:

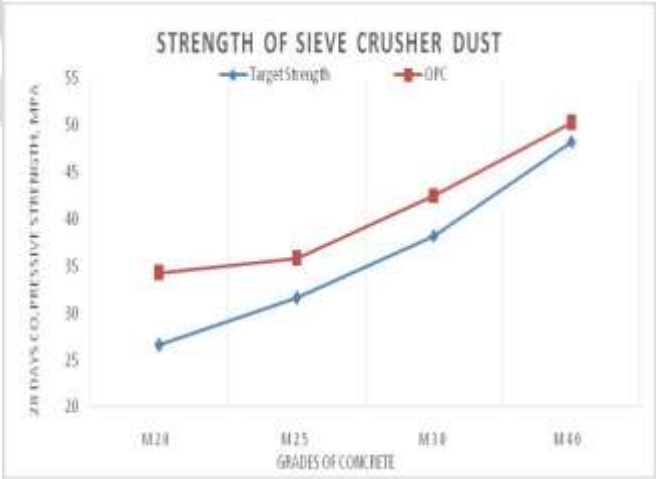
Since the initial trials have been at maximum dose of plasticizers SP 3000NR i.e. 2% of cementious material, the only option left is to use the super plasticizer which could give better results even at lower doses. Variation of Slump (in mm) with replacement level.

Strength variation in different percentage of stone dust:

Stone dust (%)	Compressive strength of cube	
	7 days	28 days
0	24.41	35.11
10	25.1	38.42
20	27.24	38.03
30	28.05	40.32
40	27.14	41.71
50	30.56	42.33



Stone dust (%)	Slump (mm) with Fixed dose of Super plasticizer (0.8%)	Slump(mm) with required dose of Super plasticizer given in bracket
0	84	60 (0.60%)
10	70	55 (0.70%)
20	55	55 (0.80%)
30	40	50 (0.90%)
40	30	48 (1.00%)
50	20	45 (1.20%)



5. CONCLUSION:

On the basis of Results obtained during the experimental investigation, following conclusions are drawn:

1. Slump (mm) of concrete made using stone dust decreases abruptly with increase in replacement level of river sand.

2. By replacing natural river sand with stone dust (10% - 50%) increased compressive strength (8% - 27%) can be achieved.

3. Stone dust can be used as an opposite substitute for fine aggregate in the case of non-availability of natural river sand at reasonable cost.

6. REFERENCES:

1. IS 456:2000 Code of Practice for Plain and Reinforced Concrete.

2. IS 10262:2009 Code for plain and reinforced concrete mix design.

3. IS 383 Specifications for Fine & Coarse Aggregate from Natural Sources for Concrete.

4. IS 2386 Methods of Tests for Aggregate for Concrete

5. IS 269:1989 – Specification for Ordinary Portland cement, 33 Grade

6. IS 383:1970 – Specification for coarse and Fine Aggregates from Natural Sources for Concrete

7. IS 2250 – Compressive Strength Test for Cement Mortar Cubes.

8. IS 269 – Specifications for 33 Grade OPC.

9. IS 8112 – Specifications for 43 Grade OPC.

10. IS 12269 – Specifications for 53 Grade OPC.

11. IS 516:1959 Method of Test for Strength of Concrete

12. IS 650:1991 Specification for Standard Sand for Testing of Cement.

13. IS 4031 – Chemical Analysis and Tests on Cement.

14. IS 456; 10262; Sp 23 – Codes for Designing Concrete mixes.

15. IS 9103 – Specifications for Concrete Admixtures.

16. Amit Kumar Singh, Vikas Srivastava, V.C. Agarwal “Stone Dust In Concrete: Effect On Compressive Strength”

17. S. P. S. Rajput1 , M. S. Chauhan2 Suitability Of Crushed Stone Dust as Fine Aggregate In Mortars

18. R. Ilangovana 1 , N. Mahendrana1 And

K. Nagamanib2 strength and Durability Properties of

Concrete Containing Quarry Rock Dust as Fine Aggregate

19. A Preliminary Concrete Mix Design for SCC with Marble Powders Author

Links Open Overlay Panelkürşat Esatalyamaçragipince

20. Concrete with Ceramic Waste Aggregate Author Links Open Overlay

Panelrm. Senthamaraiap. Devadas Manoharanb

21. The Greening of the Concrete Industry Author Links Open Overlay Panelc.Meyer