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Effect of stone dust on strength of concrete: A Review

Sumant Kumar Singh[1], Pragalbha Khare[2], Mohd. Afaque Khan[3]

[1,2] *PG Student, Department of Civil Engineering, Babu Banarsi Das University, U.P., INDIA*
[3] *Assistant Professor, Department of Civil Engineering, Babu Banarsi Das University, U.P., INDIA*

Abstract - *Stone dust is a waste material obtained from crusher plants. It has potential to be used as partial replacement of natural river sand in concrete. Use of stone dust in concrete not only improve the quality of concrete but also conserve the natural river sand for future generations. Studies shows that stone dust can be used as an alternate material for natural sand to some extend for the preparation of concrete. So hereby we studied as many useful research papers in this field and trying to improve with locally available waste material so it can be proved economical as well. Research in this field and positive results are crucial so as to continue all developments with least damage to surrounding environment and obtaining all infrastructures for services and convenience which are desired.*

Keywords: *quarry dust; crushed stone dust; durability; green concrete; sorptivity.*

INTRODUCTION

Concrete is the most common material in building construction. As the consumption of concrete increases, the demand of its component also increased. Requirement of fine aggregate is achieved from the river sand. Excess extraction of river sand from the bank of river may damage river ecosystem. On the other hand, to reduce the environmental load there should be an alternate materials of fine aggregate in concrete. Thus an investigation is needed to identify suitable substitute that is eco-friendly, inexpensive and better for strength and durability performance. In this connection the use of stone dust as fine aggregate with partial or full replacement may be a promising alternative in concrete making.

Researchers showed that river sand can be replaced by using stone dust as to give comparable strength to concrete. Stone dust has somehow similar or better mechanical properties to fine aggregate. Using of stone dust is also beneficial from the environmental aspect. Disposal of stone dust, a waste product, in the concrete construction is one of the efficient way of waste management. Many researchers worked on the mechanical properties of concrete using stone dust as fine aggregate. This review paper considered selected work on stone dust in such a way that it would become helpful for further research.

LITERATURE REVIEW

Manjunath & Rohith [1] prepared different specimen by taking soil with different percentage of stone dust (5%, 10%, 15%, 20% and 25%). All test were led according to IS 2720 standards. The results demonstrated less value of strength parameters for BC soil, but after the stabilization BC soil indicated increased value of CBR, UCC. Unconfined compressive strength improved nearly by 103% of the virgin soil after adding 15% stone dust. Adding more stone dust reduces the UCS of the BC soil.

Naman Agarwal [2] conduct experimental study on locally available soil by mixing it with Stone Dust. The percentage of stone dust by dry weight of soil was taken as 10%, 20%, 30%, 40% and 50%.The first series of compaction, specific gravity and CBR tests were conducted on the soil and the same tests were conducted in the second series on soil samples mixed with stone dust. Laboratory experiments favorably suggest that mixing stone dust with soil would be effective in improving soil properties.

1. Adding 50% of stone dust is effective in decreasing optimum moisture content of soils which is advantageous in decreasing quantity of water required during compaction.

2. The study also reveals the fact that with increase in the percentage of stone dust MDD of soil increases.

3. Mixing of soils with stone dust is also found to improve its CBR. Adding only 30% of stone dust is found to increase the CBR of soil by nearly 50%.

4. There is a great effect on specific gravity of soils on mixing stone dust with them. Adding 30% stone dust is found to be optimum in case of specific gravity.

Manchiryal R.K., Dewangan A. and Gupta D.P. [3] investigated that the physical and chemical properties of stone dust satisfied IS-2386 which could be used as replacement material of fine aggregate. Authors concentrated on cube compressive strength and beam flexure strength in order to give significance to their work. Ordinary Portland cement of 43 grade, Natural River sand with fineness modulus of 2.51 and granite aggregate as a course aggregate were used in the experiments. Quarry dust was obtained from local resource. In the experiments, river sand was 100% replaced by quarry dust and variation in strength was compared. It was concluded that compressive strength from concrete with quarry dust was comparatively 10% -12% more than the conventional concrete. They also concluded that durability under the influence of sulphate and acid attack of quarry dust concrete was higher than conventional concrete. Permeability of concrete decreased due to better relative density of quarry dust than that of conventional concrete.

Table 1: Various features of experiment by R.K. Manchiryal, A. Dewangan and D.P. Gupta

Type of specimens	Mix proportion used	Percent of replacement of F.A.	Result obtained
Cubes and Beams	----	100	Strength increased by 10%-12%

Reddy, M.V. (2010) [4] carried out some experiments using waste product like stone dust and ceramic scrap as partial and full replacement of fine aggregate. He prepared six samples of concrete in which first sample was prepared by replacing 100% fine aggregate by stone dust. Other samples were prepared by replacing 10%, 20%, 30%, 40%, 50% and 100% replacement of coarse aggregate by ceramic scrap. Mix proportion of M25 and water cement ratio of 0.48 was chosen for the investigation. He casted cubes of 150mm size, cylinders of 150*300mm size and prisms of 100*100*500mm. These samples were subjected under experimental test of compressive strength, split tensile strength and modulus of elasticity. From the result of experiment, he concluded that stone dust can be effectively used as replacement of fine aggregate but ceramic scrap should not be replaced more than 20% of coarse aggregate in order to achieve significant structural strength.

Ankit Nileshchandra Patel et al. [5] researched that stone waste is one of the most active research areas that encompass a number of disciplines including civil engineering and construction materials. They stated that the stone dust is settled by sedimentation and then dumped away which results in environmental pollution, in addition to forming dust in summer and threatening both agriculture and public health & therefore, utilization of the stone dust in various industrial sectors especially the construction, agriculture, glass and paper industries would help to protect the environment. They stated that, it is most essential to develop eco-friendly concrete from stone waste & in their research study, the (PPC) cement has been replaced by stone waste accordingly in the range of 0%, 10%, 20%, 30% 40%, & 50% by weight for M-25 grade concrete & concrete mixtures were produced, tested and compared in terms of workability and strength to the conventional concrete. These tests were carried out to evaluate the mechanical properties for 7, 14 and 28 days & as a result, the compressive strength increased up to 20% replacing of stone waste. This research work is concerned with the experimental investigation on strength of concrete and optimum percentage of the partial replacement by replacing (PPC) cement via 0%, 10%, 20%, 30%, 40% and 50% of stone waste. The aim of their investigation was to check the behavior of concrete while replacing of waste with different proportions of stone waste in concrete by using tests like compression strength.

Syam Prakash V., Krishnan D. and Jeenu G. [6] investigated the effect of stone dust on M60 grade of high strength concrete. They used Ordinary Portland Cement of 53 grade, fine aggregate of zone II and coarse aggregate of less than 20mm size. Superplasticizer was used to mitigate water cement ratio as it was needed for high strength concrete. Standard specimens of cube, cylinder and prism were cast to study different parameters. They studied compressive strength, split tensile strength, flexural strength, acid resistance property, water absorption characteristic, porosity and sorptivity through their experiments. Different samples of conventional concrete and stone dust concrete were prepared and tested. It was concluded that strengthen properties like compressive strength and tensile strength increased when stone dust was replaced by more than 60%.

Table 2: Various features of experiment by V. Syam Prakash, Dhanya Krishnan and G. Jeenu

Type of specimens	Mix proportion used	Admixture used	Parameter studied	Result obtained
Cubes, Beams and Prisms	OPC of 53 grade M60	Superplasticizer (Conplast SP 430)	Compressive strength, Split tensile strength, flexural strength, acid resistance, porosity, sorpivity	Compressive strength, tensile strength, acid resistance increased by replacing more than optimum percent (60%) of fine aggregate by stone dust

CONCLUSIONS

This literature shows that many researchers have conducted many experiments on stone dust as a replacement material for fine aggregate. All the researches shows the definite effect on the property of concrete. Following significant points can be concluded form their study:

- Concrete shows higher compressive strength after replacing fine aggregate by stone dust. So stone dust can be used as an additive in concrete preparation.

- Workability of concrete increases with the use of stone dust.

- Stone dust can be used as an alternate material of fine aggregate both in lean concrete as well as in high strength concrete. It is reported in this paper that stone dust increases the strengthen properties of concrete. However other parameters like temperature, humidity, climate conditions, air-entrapped etc. also effects the same.

So stone dust can be used as an additive in concrete preparation. Workability of concrete increases with the use

of stone dust. Stone dust can be used as an alternate material of fine aggregate both in lean concrete as well as in high strength concrete.

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BIOGRAPHIES

Mr. Sumant Kumar Singh was born in 1997 in Balia city, Uttar Pradesh. He received his Bachelor of Technology degree in civil engineering from Babu Banarasi Das University in 2016. He is right now pursuing his Master of Technology in Structural Engineering from Babu Banarasi Das University, Lucknow.

Mr. Pragalbha Khare was born in 1993 in Lakhimpur city, Uttar Pradesh. He received his Bachelor of Technology degree in civil engineering from Amity University in 2014. He is right now pursuing his Master of Technology in Structural Engineering from Babu Banarasi Das University Lucknow.

Mr. Mohd. Afaque Khan was born in 1982 in Gonda city. He received his Bachelor of Technology degree in civil engineering from ZHCET, AMU, Aligarh in 2009. In 2012 he received his Master's degree in Structural Engineering from ZHCET, AMU, Aligarh. He joined Babu Banarasi Das University, Lucknow in 2012 as a faculty. He worked as head of the department in Babu Banarasi Das Engineering College, Lucknow and is now working as an assistant professor in Babu Banarasi Das University, Lucknow (Department of civil Engineering) with a total of 6 years of experience.