ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 07, Issue, 07, pp.13767-13770, July, 2017

ORIGINAL RESEARCH ARTICLE

Open Access

HIGH PERFORMANCE CONCRETE WITH PARTIAL REPLACEMENT OF QUARRY DUST AND SILICA FUME

***Prakash R.**

Assistant Professor, Department of Civil Engineering, A.C. College of Engineering and Technology, Karaikudi 630 003, Tamilnadu, India

ARTICLE INFO

Article History:

Received 25th April, 2017
Received in revised form
14th May, 2017
Accepted 06th June, 2017
Published online 22nd July, 2017

Key Words:

High performance concrete,
Silica fume, Quarry dust and
Compressive strength.

ABSTRACT

In engineering industry, the improvement of existing materials allows for technological advancement and the construction of more reliable structures without over design. High performance concrete a material widely utilized in heavy structural construction is cheap and dependable material that can be studied to reach its optimum performance. When the general performance of concrete is substantially higher than that of normal concrete, such concrete is regarded as high Performance concrete. In this study the compressive strength of HPC with silica fume of 15% replacement by the weight of cement and quarry dust as partial and full replacement of fine aggregate is investigated. Results were found that the silica fume is beneficial to concrete in increasing the compressive strength of concrete and quarry dust replacement further increasing the compressive strength of high performance concrete. A compressive strength of 23% is increased due to inclusion of silica fume and 12.4 % is increases due to the replacement of quarry dust.

****Corresponding author:***

Citation: Prakash R, 2017. "High performance concrete with partial replacement of quarry dust and silica fume", *International Journal of Development Research*, 7, (07), 13767-13770.

INTRODUCTION

One of the greatest technological challenges of the present time is to utilize the large amount of industrial and building wastes, which are generated as a result of the development of modern society. At present, only a merge amount of wastes are used meaningfully and the major portion is being deposited or used as filler material. With the increase in construction activities and shortage of suitable deposit sites, the industrial wastes are becoming a serious problem, which has forced the Civil Engineering professionals and Researchers to seriously think and develop methods of reuse of waste in new construction. Concrete Technology has been already played a significant role in waste management system by employing the industrial wastes efficiently, without any compromise in the quality of end product. The utilization of Quarry Sand as fine aggregate in the production of concrete is attractive and effective when this fine aggregate is competitive with the natural resources in relation to cost and quality. The utilization of waste will provide opportunities for saving energy, time, natural resources and destruction caused in human health. With the use of waste material, cost benefits can also be achieved. With a view to overcome the environmental problems and scarcity of building materials, the Quarry Wastes are employed for concrete making and various other purposes. For predicting its suitability, it has to be tested and compared with the conventional one with respect to its application. The High performance concrete is used for the very large and heavier structures like Bridges, High rise Buildings, Tunnels and Nuclear power plants. High Performance concrete is a development of the concrete. The high strength is yield at either very nearly or at 28 days, or even later. In some applications, a high modulus of elasticity is the property sought. Nowadays 60 MPa is considered as a high strength concrete. High Strength is achieved by low water cement ratio below 0.35. High performance is specified in order to exploit

there is no technical difficulties during mixing of concrete. Abrasion resistance of high performance concrete is very good, not only because of the strength of the concrete, but also because of the good bond between the coarse aggregate and the matrix, which prevents differential wear of the surface. The absence of open pores in the surface zone of high performance concrete prevents growth of bacteria. In presence of silica fume can be incorporated in high performance concrete for the purpose of reducing the early development of the heat of hydration, as well as of improving strength. The categorization of high performance concrete as resistant, or not resistant, to freezing and thawing is complicated by fact that ASTM C 666-03(2008) consider to be usual a test at an early age without allowing the concrete to dry out.

Experimental results of Sudharsana roa (2014) says that the silica fume content increases the compressive strength increases up to 15% and then decreases. Also the percentage replacement of cement by silica fume increases, the workability decreases. Shanmugapriya (2012) conclude from experimental researchers that compressive strength of concrete can be improved by partial replacement of cement by Silica fume and manufactured sand for natural fine aggregates. They suggested that the optimum replacement natural sand by manufactured sand is 50%. Saeed ahmad (2008) have found that the compressive strength of various mix ratios increased from 7% to 33% where as workability decrease from 11% to 67% with increasing proportion of manufactured sand. Experimental results of Shyam Prakash (2007) shows that manufactured sand satisfies the requirements of fine aggregate such as strength, gradation, shape angularity. It is also possible to produce manufactured sand falling into the desired grade. They say that the mechanical properties of manufactured sand different upon the source of its raw material, i.e., parent rock. Hence the selection of quarry very important to quality fine aggregate. Shanmugapriya T and Uma R.N made an investigation on optimization of partial replacement of natural sand by M-sand in high performance concrete with silica fume. It was reported that M sand and silica fume increased the flexural and compressive strength. In this study an attempt is made to evaluate the characteristics of High Performance Concrete (HPC) using quarry dust as alternative to the river sand and silica fume is partial replacement of cement.

MATERIALS AND METHODS

Quarry dust: Sand is an important ingredient for making cement concrete sand is. River sand is most commonly used for making concrete. Nowadays, because of growing construction field, there is a huge demand of sand. This results in sand scarcity. So we are forced to find substitution for sand. At the same time the dust from crushers dump the crushed stone dust in ground. According to crushers, crushed stone dust is waste materials. The dumping of crushed materials disposal makes ground pollutions and also environmental problems. Not only for demand of sand but also have had we taken sand from river bed. If we can use this crushed stone dust, is making by either in partly or in fully replacement of natural river sand, then this will not only save the cost of construction but also the problem of disposal of quarry dust.

Silica fume

Silica fume also known as micro silica is an amorphous polymorph of silicon dioxide, silica. It's an ultrafine material with spherical particles less than 1µm in diameter which is approximately 100 times less than the average cement particle. Because of its extreme fineness and high silica content, it's added to concrete to improve its properties, in particular its compressive strength, bond strength, abrasion resistance and durability. It also reduce bleeding and permeability. So that it protects the reinforcing steel of concrete from corrosion.

Mix methodology

The Indian code had provided the mix design procedure for upto the grade of M55. Hence, the mix proportioning is done based on American Concrete Institute (ACI 211.4R-93) recommendations. The high performance concrete (M80) is achieved by having low water - cement ratio. Table 1 shows the mix proportion of HPC used in this study. In this proportion a constant percentage of silica fume (15%) is added for all the mix.

Table 1. Mix proportions

Water (kg/m^3)	Cement (kg/m^3)	Fine aggregate (kg/m^3)	Coarse aggregate (kg/m^3)
173.75	668.26	588.655	1027.2
0.26	1	0.88	1.54

Test on hardened concrete

Compressive test is carried out on cubical specimens adopting IS procedure at 7, 21 and 28 days. The compressive strength test results and discussions based on the test results are presented in the next chapter. In this project concrete was casted in cube size of 150×150×150 mm. Before that sample cubes were casted to found out the dosage of super plasticizer to be added to concrete while casting. From the samples the optimum dosage is found out to be 1.2% of weight of cement.
From the testing machine, the compressive load acting on the cube samples were obtained. The compressive strength is calculated by

Compressive strength = (compressive load)/(specimen area) N/mm^2

The Concrete cube casted and testing of concrete cube for compressive strength is shown in Figue 1.

Figure 1. Concrete cube for Compressive strength

RESULT AND DISCUSSION

Totally 81 numbers of oncrete cube specimens with various percentage of Quarry Sand were casted and tested at 7, 14,21 and 28 days respectively and the results are presented in the Table 2.

Table 2. Compressive strength of concrete

Sl.No	Silica fume	Sand%	Quarry Dust %	Compressive strength of concrete N/mm^2			
				7 days	14 days	21 days	28 days
1.	15 %	100	0	72.5	83.2	90.3	98.5
2	15 %	90	10	74.2	85.4	92.2	100.3
3	15 %	80	20	75.3	86.3	94.5	102.0
4	15 %	70	30	77.7	88.5	95.5	103.5
5	15 %	60	40	81.5	90.6	98.3	106.5
6	15 %	50	50	84.6	93.2	100.7	110.9
7	15 %	40	60	80.3	90.3	97.4	105.5
8	15 %	30	70	77.1	88.4	95.5	103.2
9	15 %	20	80	71.8	83.6	90.6	97.3
10	15 %	10	90	68.6	80.4	87.4	94.5
11	15 %	0	100	65.6	77.3	84.3	91.4

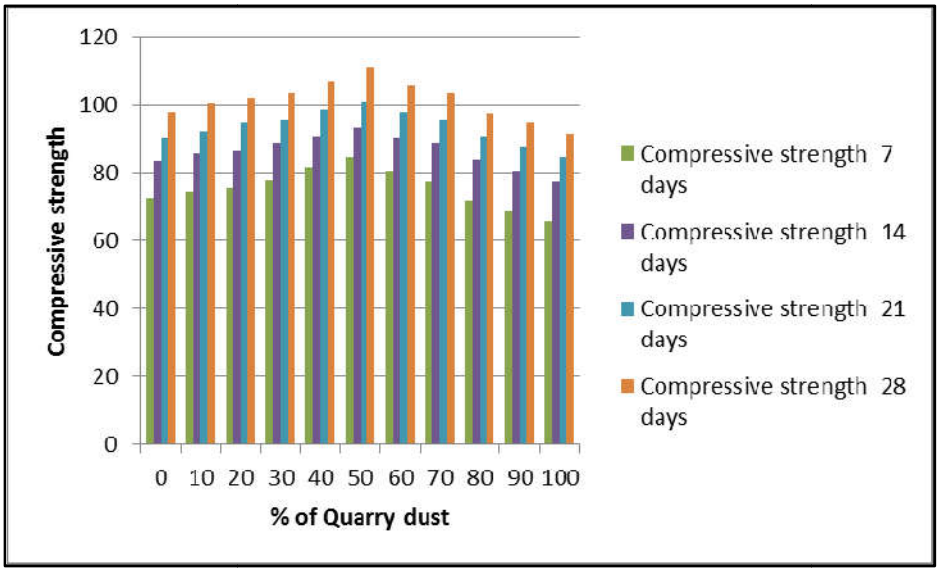

Figure 2. Compressive strength

The Bar chart of Compressive strength for various replacement percentage of quarry dust is shown in Fig.1. The addition of 15 % silica fume increased the compressive strength of concrete from 80 N/mm^2 to 98.5 N/mm^2 in the control concrete mix.. The compressive strength of concrete is increasing when quarry dust replacement percentage increasing and it goes on increasing up to 50 % replacement of Quarry dust. Maximum compressive strength of 110.9 N/mm^2 is achieved by replacing 50 % of sand by quarry dust which is about 12.4 % higher over control concrete. This increase in compressive strength may be due to the interlocking of quarry dust with river sand in the concrete. When the quarry dust percentage increases beyond 50% the compressive strength of concrete decreases and the least compressive strength value is found in 100% replacement of quarry dust. Hence 50 % of quarry dust replacement is found optimum in high performance concrete.

Conclusion

The following are the conclusions made from this study,

- There is a gradual increase in compressive strength of High Strength Concrete with increase in the Quarry dust up to 50%. There is 12.4% increase in the compressive strength is achieved when compared to the control concrete. It is also found that there is decrease in compressive strength of High Strength Concrete when the quarry dust proportion increasing beyond 50%. It may be due to very low workability and flaky nature of quarry dust.
- From this study, it is evident that the Quarry Sand may be used as effective replacement over the natural River Sand for the production for high strength concrete of grade M100 concrete up to 50% replacement.
- The inclusion of quarry dust in high strength not only reduce the cost of high strength concrete but also save the environment by avoiding land filling of quarry dust in agricultural area which leads to infertility of land.

REFERENCE

Sudarsana Rao.Hunchate, "Mix Design of High Performance Concrete Using Silica Fume and Super plasticizer", *International Journal of Innovative Research in Science, Engineering and Technology*, Vol 3,issue 3, Mar 2014.

ACI 211.4R-93, Guide for Selecting Proportions for High-Strength Concrete with Portland Cement and Fly Ash. 3. IS 383:1970, Specification for coarse aggregate and fine aggregate from natural sources for concrete, BIS, New Delhi.

M.S.Shetty. 2005. Concrete Technology Theory and Practice, S.Chand and Company Ltd, New Delhi.

Nimitha Vijayaraghavan, effects of manufactured sand on compressive strength and workability of concrete,

International journal of structural and civil engineering research, Vol.2 ,No.4, Nov 2013.

Mahendra R Chitlange and Prakash S Pajgade (2010), "Strength Appraisal of Artificial Sand as Fine Aggregate", In SFRC Asian Research Publishing Network *Journal of Engineering and Applied Sciences*, Vol. 5, pp. 34-38.

Shanmugapriya T and Uma R N (2012),"Optimization of Partial Replacement of M-Sand By Natural Sand In High Performance Concrete With Silica Fume", *International Journal of Engineering Sciences & Emerging Technologies,* Vol. 2, pp. 73-80.

Saeed Ahmad and Shahid Mahmood (2008), "Effects of Crushed And Natural Sand on The Properties of Fresh and Hardened Concrete", 33rd Conference on Our World In Concrete & Structures, Singapore, pp. 25-27

****