

Strength and Durability Properties of High Strength Concrete by Using Quarry Dust as Fine Aggregate

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ABSTRACT: River sand is the most commonly used fine aggregate in the production of concrete; but the river sand is expensive due to excessive cost of transportation from natural sources, and also large scale depletion of this material creates environmental problems. This paper focus on replacement of sand with quarry dust and silica fume has been added as a percentage of replacement of cement by 5% and 10%. To increase the workability and flow ability of fresh concrete, super plasticizer has been added. Based on the test results, in the presence of silica fume, quarry dust can be used as a fine aggregate in concrete and it will improve the strength characteristics as well as durability characteristics. Considering various alternative material quarry dusts may be the best substitute material to sand in concrete.

KEYWORDS: River sand, Quarry Dust, Silica Fume, Super plasticizer, Durability characteristics.

I. INTRODUCTION

Currently India has taken a major initiative on developing the infrastructures such as express highways, power projects and industrial structures etc., to meet the requirements of globalization, in the construction of buildings and other structures concrete plays the rightful role and a large quantum of concrete is being utilized. River sand, which is one of the constituents used in the production of conventional concrete, has become highly expensive and also scarce. In the backdrop of such a bleak atmosphere, there is large demand for alternative materials from industrial waste.

II. MATERIALS USED

Cement	Ordinary Portland cement(43-grade)
Fine aggregate	Quarry dust
Coarse aggregate	12mm(angular)
Mineral admixtures	silica fume(EROSIL-NV/200 XL 5M)
Super plasticizer	Conplast sp430

III. EXPERIMENTAL RESULT

COMPRESSIVE STRENGTH TEST

It is one of the most important properties of concrete and influences many other describable properties of the hardened concrete. The mean compressive strength required at a specific age, usually 28 days, determines the nominal

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water-cement ratio of the mix. Compressive strength of concrete is usually found by testing Cubes. Cube of size 100mm x 100mm x 100mm and concrete specimens were casting using M40 grade concrete.

Table 1 Test Result of Cube for Compression

S.no	Curing days	Average compressive strength in N/mm ²		
		Quarry dust Concrete (0.9% sp)	Quarry dust with Silica fume 5% (0.9% sp)	Quarry dust with Silica fume 10% (0.9% sp)
1	28	43.3	49	48
2	60	44	49.06	48.26
3	90	45.06	49.20	48.40

ACID TEST

In order to assess the weight loss concrete cubes is exposed to chemical media. For acid test hydrochloric acid was prepared by mixing 5% of Hcl with one liter of water as per ASTM G20-8. After normal curing (28 days) cubes were taken out and weight of cube was noted. Than weighted cubes was immersed in the prepared hydrochloric acid for 60 days. After 60 days the cubes were taken out from acid and weight of cubes was noted. From this weight loss of cubes is find out.

$$\text{Weight loss} = \text{weight of cube after normal curing} - \text{weight of cube after taken from acid}$$

Table 2 Test Result of Acid Attack

S no	Type of concrete	Avg weight Before put in to Acid (kg)	Avg weight After taken from Acid attack (kg)	Loss in (kg)	Percentage Loss
1	Quarry Dust Concrete	2.337	2.311	0.026	2.6%
2	Quarry Dust with Silica fume 5%	2.381	2.359	0.022	2.2%
3	Quarry Dust with Silica fume 10%	2.404	2.385	0.019	1.9%

ALKALINE TEST

To assess the weight loss concrete cubes is exposed to chemical media. For alkaline test sodium hydroxide was prepared by mixing 5% of sodium hydroxide with one liter of water as per ASTM G20-8. After normal curing (28 days) cubes were taken out and weight was noted. Than weighted cubes was immersed in the prepared sodium hydroxide solution for 60 days. After completion of 60 days concrete cubes were taken out and weighted. Than weight loss is calculated.

Table 3 Test Result of Alkaline Attack

S.no	Type of concrete	Avg weight Before put in to Alkaline (kg)	Avg weight After taken from Alkaline attack (kg)	Loss in (kg)	Percentage Loss
1	Quarry Dust Concrete	2.346	2.330	0.016	1.6
2	Quarry Dust with Silica Fume 5%	2.458	2.444	0.014	1.4
3	Quarry Dust with Silica Fume 10%	2.388	2.378	0.010	1

IV. CONCLUSION

Based on the test results the following conclusions are drawn.

- Quarry dust as fine aggregate did not affect the unit weight and air content of fresh concrete.
- The 100% replacement of natural sand with quarry dust slightly affects the compressive strength of concrete. This due to the excessive fineness content and inappropriat content of 10 mm and 12 mm coarse aggregate.
- In case of concrete with silica fume quarry dust there is a significant improvement in compressive strength of concrete because of the high pozzolanic nature of silica fume and its void filling ability.
- The combined use of quarry dust fine aggregate and silica fume exhibiting excellent against acid and alkaline attack.

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