

Mechanical Properties Of Modified Concrete Using Quarry Dust As A Substitute Of Fine Aggregate

U.Umamaheshwari, D.Prasannan

Abstract— Common river sand is expensive due to excessive cost of transportation from natural sources. Also large-scale depletion of these sources creates environmental problems. As environmental transportation and other constraints make the availability and use of river sand less attractive, a substitute or replacement product for concrete industry needs to be found. River sand is most commonly used fine aggregate in the production of concrete poses the problem of acute shortage in many areas. Whose continued use has started posing serious problems with respect to its availability, cost and environmental impact? In such a situation the Quarry rock dust can be an economic alternative to the river sand. Quarry Rock Dust can be defined as residue, tailing or other non-volatile waste material after the extraction and processing of rocks to form fine particles less than 4.75mm. Usually, Quarry Rock Dust is used in large scale in the highways as a surface finishing material and also used for manufacturing of hollow blocks and lightweight concrete prefabricated Elements. Use of Quarry rock dust as a fine aggregate in concrete draws serious attention of researchers and investigators.

This project presents the feasibility of the usage of Quarry Rock Dust as hundred percent substitutes for Natural Sand in concrete. Mix design has been developed for three grades using design approach IS, ACI, USBR, RN.No.4 and BRITISH for both conventional concrete and quarry dust concrete. Tests were conducted on cubes and beams to study the strength of concrete made of Quarry Rock Dust and the results were compared with the Natural Sand Concrete. An attempt has also been made to durability studies on Quarry Rock Dust when compared with the Natural Sand concrete. It is found that the compressive, flexural strength and Durability Studies of concrete made of Quarry Rock Dust are nearly 10% more than the conventional concrete.

Keywords: Common river sand, Quarry rock dust, Natural Sand Concrete.

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. The utilization of Quarry rock dust which can be called as manufactured sand has been accepted as a building material in the industrially

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advanced countries of the west for the past three decades. As a result of sustained research and developmental works undertaken with respect to increasing application of this industrial waste, the level of utilization of Quarry Rock Dust in the industrialized nations like Australia, France, Germany and UK has been reached more than 60% of its total production. The use of manufactured sand in India has not been much, when compared to some advanced countries.

This project presents the feasibility of the usage of Quarry Rock Dust as hundred percent substitutes for Conventional Concrete. Tests were conducted on cubes and beams to study the compressive, flexural strengths of concrete made of Quarry Rock Dust for three different proportions and five different methods. Durability Studies were done for concrete with Quarry Rock Dust and compared with the Conventional Concrete.

II. INVESTIGATION METHODOLOGY INVESTIGATION PROPOSED

Experimental investigations have been proposed on Ultra High Strength Concrete containing mineral admixtures to know whether the replacement of river sand using quarry dust gives higher mechanical properties.

Following tests are proposed to be carried out for the Ultra High Strength Concrete containing mineral admixtures under different curing conditions (Normal Curing).

1. Compressive strength at 7days, 14 days and 28 days.
2. Split tensile strength at 14 days and 28 days.

In this research, river sand is proposed to be replaced by quarry dust about 80% and 100%.

III. PHYSICAL AND CHEMICAL PROPERTIES OF QUARRY DUST AND NATURAL SAND

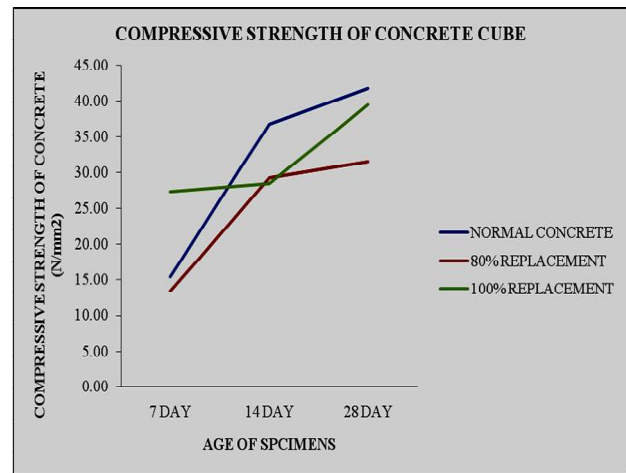
Table-1. Physical properties of quarry rock dust and natural sand.

Property	Quarry rock dust	Natural sand	Test method
Specific gravity	2.54-2.60	2.60	[5] IS 2386 (Part III) 1963
Bulk relative density (kg/m ³)	1720-1810	1460	IS 2386 (Part III) 1963
Absorption (%)	1.20-1.50	Nil	IS 2386 (Part III) 1963
Moisture content (%)	Nil	1.50	IS 2386 (Part III) 1963
Fine particles less than 0.075mm (%)	12-15	06	[5] IS 2386 (Part I) 1963
Sieve analysis	Zone II	Zone II	[4] IS 383 - 1970

Table-2. Typical chemical composition of quarry rock dust and natural sand.

Constituent	Quarry rock dust (%)	Natural sand (%)	Test method
SiO ₂	62.48	80.78	[10]IS: 4032-1968
Al ₂ O ₃	18.72	10.52	
Fe ₂ O ₃	06.54	01.75	
CaO	04.83	03.21	
MgO	02.56	00.77	
Na ₂ O	Nil	01.37	
K ₂ O	03.18	01.23	
TiO ₂	01.21	Nil	
Loss of ignition	00.48	00.37	

	STRENGTH OF CONCRETE IN 'N/mm ² '		
	7 DAY	14 DAY	28 DAY
NORMAL CONCRETE	15.47	36.76	41.78
80% REPLACEMENT	13.33	29.20	31.42
100% REPLACEMENT	27.29	28.44	39.47



ADVANTAGES

- Quarry dust has greater durability than the ordinary sand.
- It has high strength.
- Usage of quarry dust can overcome the defects occurring in concrete such as honey combing, segregation, voids, capillary etc.
- It has greater workability.
- Eco friendly.
- The compressive strength of concrete under different Percentage of quarry dust.

WATER ABSORPTION IN COARSE AGGREGATE

Water absorption = 1.96 %

SPECIFIC GRAVITY OF AGGREGATE

Specific gravity of the coarse aggregate = 2.94

SPECIFIC GRAVITY OF FINE AGGREGATE:

Specific gravity of the given fine aggregate = 2.2

SPECIFIC GRAVITY OF QUARRY DUST

Specific gravity of the quarry dust = 2.47

M30 Mix design

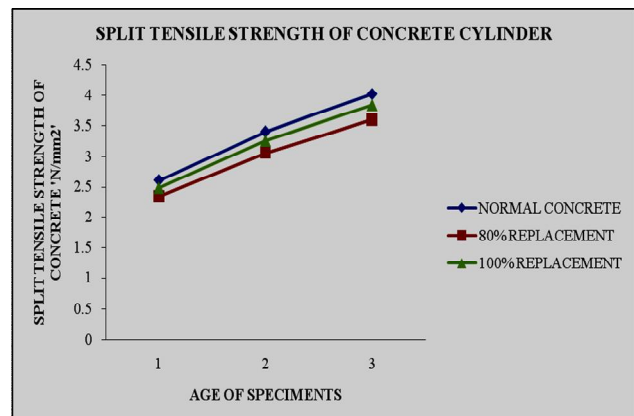
Water	Cement	Fine aggregate	Coarse aggregate
191.6	456.19 kg	536.33 kg	1267.24 kg
0.42	1	1.16	2.25

COMPRESSIVE STRENGTH TEST RESULTS:

DESCRIPTION	COMPRESSIVE
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SPLIT TENSILE STRENGTH TEST RESULTS

DESCRIPTION	SPLIT TENSILE STRENGTH OF CONCRETE IN 'N/mm ² '		
	7 DAY	14 DAY	28 DAY
NORMAL CONCRETE	2.61	3.41	4.02
80% REPLACEMENT	2.34	3.06	3.6
100% REPLACEMENT	2.49	3.26	3.83



IV. CONCLUSION

All the experimental data shows that the addition of the industrial wastes improves the physical and mechanical properties. These results are of great importance because this kind of innovative concrete requires large amount of fine particles. Due to its high fines of quarry dust it provided to be very effective in assuring very good cohesiveness of concrete. From the above study it is concluded that the quarry dust may be used as a replacement material for fine aggregate. Quarry dust has been used for different activities in the construction industry such as for road construction and manufacture of building materials such as light weight aggregates, bricks, tiles and auto clave blocks. However its use as rigid payment is very much limited. Thorough reaction with the concrete admixture, quarry dust, improved pozzolanic reaction, micro aggregate filling and concrete durability. As the properties are good as sand, the quarry dust is used as fine aggregate in replacement with sand in the cement concrete

For 80% replacement of quarry dust in concrete gives 75% of compressive strength of normal concrete, and tensile strength of modified concrete is 89% strength only gets. Whereas 100% replacement of quarry dust in concrete gives 94.47% of compressive strength of normal concrete, and tensile strength of modified concrete is 95% of strength gets. It is more than 80%

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