Use of Stone Dust in Artificial Sand

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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. The study was conducted to evaluate workability and the strength characteristics of concrete with variable dust percentage in artificial sand. The concrete mix design was done for M25 grade concrete. The mix is prepared for natural and artificial sand containing dust varying from 0%, 10%, 20% to 30%. The concrete mix properties were studied in fresh and hardened state for that slump cone test.**

The study was conducted to evaluate the strength characteristics of concrete with variable dust percentage in artificial sand. The concrete mix design was done for M25 grade concrete. In this study dust which is a waste material stone crusher plant was used as a additive in artificial sand and the concrete made by using artificial sand with 20 % dust were found to be satisfactory. The workability of concrete made by using artificial sand with dust as additive was found greater than natural sand made concrete.

Index Terms **- Artificial sand, Stone dust, Slump test, Compressive strength, Workability of concrete.**

INTRODUCTION

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 artificial sand can be an economic alternative to the river sand.

Manufactured Sand is produced by feeding hard stones of varying sizes to primary and secondary crushers (Jaw crusher and Cone crusher), for size reduction and these crushed stones are further crushed in Vertical Shaft Impact (VSI) crusher to reduce the particle size to that of sand. The VSI crusher by its unique design and action of attrition produces well shaped fine aggregate particles that are cubical and angular. There are certain other measures also can be adopted to produce manufactured sand.

Although the Is code 383 :1970 has allowed to use artificial sand containing dust up to 20 percentage, it seems there is no awareness in contractors and people about artificial sand. This study involves discussing various properties of concrete made by using artificial sand containing dust to achieve economy, strength, quality and to promote the use of artificial sand. 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. to meet these requirements artificial sand can be used effectively.

Pofale and Quadri (2013) had taken up investigation with a view to verify the suitability, feasibility and potential use of crusher dust, a waste product from aggregate crushing plant in concrete mixes, in context of its compressive strength workability and in terms of slump, compacting factor, flow table and modified

flow . Mogre and Parbat (2013) Presented the study of replacement of natural sand with artificial sand in concrete conventionally concrete is a mix of cement sand and aggregate there is a large variation in the strength of concrete due to variation in strength of aggregate. Singh and P.K. Mehta (2014) Concrete grade M- 25 concrete mix was used investigation. The test results indicate that stone dust can be effectively used in partial replacement of fine aggregate in concrete. S.D. Vikhe et al: (2018) The maximum strength of test 7 was found as 16.44 N/mm2 and 28.66 N/mm2 for 7 and 28 days respectively which more among all the combinations. For all mixes observed slump value lies between 30 to 45 mm. Thus cement, stone dust, sand, and coarse aggregate proportion of 6:4.8:7.2:24 gave optimum result.

In this research work the concrete mix was done for concrete M-25 grade, the mix was prepared for natural and artificial sand containing dust varying from 0%,10% ,20% to 30%. The concrete mix properties were studied in fresh and hardened state for that slump cone test, compressive strength test.

MATERIALS AND METHODS

Cement

53grade Ordinary Portland cement (BIRLA cement) is used throughout the experimental work.

Coarse aggregate

Locally available crush stone with size 20mm and 10m m confirming to IS 383:1970 are used.

Table 1. Properties of the coarse aggregate

Sr. No	Test	Results
01	Specific gravity	2.87
02	Crushing value	10.78%
03	Impact value	4.3%
04	Fineness modulus	6.42
05	Water absorption	1.06 %

Table 2. Properties of artificial sand

Sr. No	Test	Results
1.	Fineness modulus	3.22
2.	Water absorption	2.876 %
3.	Specific gravity	2.722

Table 3. Summary of Concrete Mix Design

Observation and Calculation		
1	Characteristic Compressive Strength	25 N/mm^2
2	Degree of quality control	Good
3	Standard deviation(S)	4
4	Target mean compressive strength, $F_t = f_{ck} + 1.65 \times S$	31.6N/mm^2
5	W/C ratio	0.52
6	Type of cement	OPC
7	Nominal size of coarse aggregate	20mm
8	Specific gravity of cement, S_c	3.15
9	Specific gravity of fine aggregate, S_{fa}	2.722
10	Specific gravity of coarse aggregate, S_{ca}	2.87
11	Water content per m^3 of concrete	223.98 Kg/m^3
12	Cement content for W/C = 0.5	425.73 Kg/m^3
13	Total fine aggregate per m^3 of concrete, F_a	658.6 Kg/m^3
14	Total coarse aggregate per m^3 of concrete, C_a	1204.489 Kg/m^3

Casting procedure

Cubes were casted for natural and artificial sand containing dust to check the compressive strength of concrete. The percentage of dust were varied as 0%, 10%, 20%, & 30% by weight of artificial sand. Compressive test is carried to determine compressive strength of concrete cubes. It is the most common test conducted on hardened concrete partly because it is an easy test to perform and partly because most of the desirable characteristics properties of concrete are quantitatively related to its compressive strength. The compressive test was carried out on cube specimen of the test size 15x15x15 cm.

Before assembling the mould, their mating surfaces were covered with mineral oil and a thin layer of the oil was applied to its inner surface to prevent a bond development between the mould and the concrete. Mix the concrete ingredients thoroughly as per the mix design. Concrete ingredients are filled in to the mould in three layers and each layer is compacted by tamping rod not less than 25 blows or by using surface vibrator. Then level the top surface and smoothen it with the trowel.

The test specimens are stored in a moist air for 24 hours and after this period the specimen are removed from the mould and marked. Then cubes kept in the clear fresh water until taken out prior to test. Minimum three specimens should be tested at each selected age. If strength of any specimen varies more than 15 percent of average strength results of such specimen was rejected. Average of three specimens gives the compressive strength of concrete.

Workability test on concrete by Slump cone test

The slump test is the most well-known and widely used test method to characterize the workability of fresh concrete. The inexpensive test, which measures consistency, is used on job sites to determine rapidly whether a concrete batch should be accepted or rejected. The test method is widely standardized throughout the world. The apparatus consists of a mold in the shape of a frustum of a cone with a base diameter of 20 cm a top diameter of 10 cm, and a height of 30 centimeters. The mold is filled with concrete in three layers of equal volume. Each layer is compacted with 25 strokes of a tamping rod. The slump cone mold is lifted vertically upward and the change in height of the concrete is measured. The only type of slump permissible is frequently referred to as the true slump, where the concrete remains intact and retains a symmetric shape. A zero slump and a collapsed slump are both outside the range of workability that can be measured with the slump test. Specifically, IS advises caution in interpreting test results less than 1.25 cm and greater than. If part of the concrete shears from the mass, the test must be repeated with a different sample of concrete. A concrete that exhibits a shear slump in a second test is not sufficiently cohesive and should be rejected.

RESULTS AND DISCUSSION

The test procedure followed was as per the specifications of the relevant Indian standards. The test was carried out after 7, 28 days of curing and test results are as follows.

Table 4. Test result for cubic compressive strength of concrete.

For Natural sand	7days compressive strength (N/MM^2)	28days compressive strength (N/MM^2)
	36.44	37.778
% Replacement of Artificial Sand by Dust	7Days Compressive Strength (N/MM^2)	28Days Compressive Strength (N/MM^2)
0%	27.94	41.1
10%	25.775	38.66
20%	24.314	37.800
30%	21.644	29.742

From above table it is found that compressive strength of concrete using artificial sand found less than that of natural sand for test conducted at 7 days but for 28 days strength found more than natural sand for replacement of artificial sand with less than 20 percent dust. The detailed comparison is shown in table no 5

Table 5 Comparison of Compressive Strength Result with Target strength of concrete

% Replacement of Sand by dust	Target mean comp. strength(N/MM^2)	28Days Compressive Strength(N/MM^2)	% Increase	% Decrease
0%	31.6	41.1	30.06	
10%		38.66	22.34	
20%		37.800	19.62	
30%		29.7422		5.88

Table 6 Workability for different mixes

Sr. No	Type of Mix	Slump value
1	Concrete mix for natural sand	95
2	Concrete mix for artificial sand	90
3	Concrete mix with 10% dust	102
4	Concrete mix with 20% dust	98
5	Concrete mix with 30% dust	104

From above table it observed that as increase in percentage of stone dust in artificial sand slump value also increases.

CONCLUSION

The study was conducted to evaluate the strength characteristics of concrete with variable dust percentage in artificial sand. The concrete mix design was done for M25 grade concrete. In this study dust which is a waste material stone crusher plant was used as a additive in artificial sand and the concrete made by using artificial sand with 20 % dust were found to be satisfactory. The workability of concrete made by using artificial sand with dust as additive was found greater than natural sand made concrete.

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