International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 11 | Nov -2017 www.irjet.net p-ISSN: 2395-0072

An Experimental study on Effects of Quarry Dust as Partial Replacement of sand in concrete

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Abstract - *This experimental study presents the various effects on concrete, if the natural sand replaced by quarry dust. To find the effect of quarry dust various tests are conducted like compressive strength test and workability test (compaction factor). The set of series are, M20 & M25 grade of concrete with 10, 20, 30, 40, 50 and 60 percentage replacement of quarry dust tested for 7 days, and 28 days is studied and the results are presented. 50% replacement of sand by quarry dust gives higher compressive strength than natural sand concrete.*

Key Words: Concrete, quarry dust, river sand, compressive strength, replacement.

1.INTRODUCTION

The motive of this study is to determine the effect of quarry dust in concrete as fine aggregate to finding an alternative of natural sand . The developing countries like India needed to search alternative of construction materials to fulfill the demands and gives economical secondary material to construction industries as well as it is important from environmental corner.

Quarry dust is a byproduct of the crushing process which is a concentrated material to use as aggregates for concreting purpose, especially as fine aggregates. the rock has been crushed into various sizes, in quarrying activities; during the process the dust generated is called quarry dust and it is formed as waste and its become a useless material.

2. Literature Review

The suitability of quarry dust as a sand replacement material shows that the mechanical properties are improved and also elastic modulus. The compressive strength achieved optimum by replacing fine aggregate with quarry dust in ratio of 60 : 40 as done by Hmaid Mir [1].

Felekoglu et al. [2] observed that the incorporation of quarry waste at the same cement content generally reduced the super plasticizer requirement and improved the 28 days' compressive strength of SCC. Normal strength SCC mixtures that contain approximately 300–310 Kg of cement per cubic meter can be successfully prepared by employing high amount of quarry waste. Sukumar et al. [3] found that the relations have been established for the increase in compressive strength at premature ages of curing (12 h to 28 days) for different grades of SCC mixes and are compared with the IS Code formula for straight concrete as per IS: SP 23-1982. Ho et al. [4] explained that the granite fines can be used in the SCC production. However, it is important to spot out that, as a waste material, the properties of stone fines are likely to vary with time. Then, after that, the fineness of granite fines could solve durability problems, such as silica-alkali reactions. These two issues would require to be addressed if the material is to be used with assurance.

Utilization of quarry dust in concrete is recommended particularly in regions where sand is not easily available (Dehwah [5]).

Muhit et al. [6] determined that passing from 200 mm sieve is used as cement replacement whereas retaining from 100 mm sieve is used as sand replacement. Cement was replaced with stone dust in percentage of 3, 5, and 7 percent. Similarly, sand was replaced with stone dust in percentage of 15 to 50 with an increase of 5 percent. Test result gives that compressive strength of mould with 35% of sand and 3% of cement replacing dust increases to 21.33% and 22.76% in that order compared to the normal mortar mould at 7 and 28 days for tensile strength which increased to 13.47%.

Ukpata and Ephraim [7] identified the flexural and tensile strength properties compared with those for normal concrete. Hence, concrete proportion of lateritic sand and quarry dust can be used for construction provided the mixture of lateritic sand content is reserved below 50%. Both flexural strength and tensile strength are increased with increase in lateritic content.

According to Soutsos et al. [8], the physical characteristics of recycled destruction aggregates may unfavorably affect the properties of the blocks. However, levels of replacement of quarried stone aggregates with destruction recycled aggregates determined that it will not have significant harmful effect on the compressive strength.

It is observed that there is consistent increase in the strength of plain concrete when natural sand is fully replaced by quarry dust (Chitlange and Pajgade [9]).
Concrete containing quarry dust as fine aggregate can be effectively utilized in the construction industry with good quality materials, appropriate dosage of super plasticizer, appropriate mixing methods, and proper curing thereby ensuring sustainable development against environmental pollution (Devi and Kannan [10]).

The investigation proposes that the stone dust can be replaced up to 50% without any effect on mechanical and physical properties and the economical saving will be 56% also as discussed by Nanda et al. [11].

The study of Ilangovana et al. [12] gives attention to physical and chemical properties of quarry dust with respect to requirements of codal provision which are satisfied. The 100% replacement of sand with quarry dust gives better results in terms of compressive strength studies.

3. Test on Quarry Dust

3.1 Compressive Strength Test

Coarse aggregate of 20mm maximum size is used in Reinforced cement concrete work of all types of structures. This is obtained by crushing the stone boulders of size 100 to 150mm in the stone crushers. Then it is sieved and the particles passing through 20 mm and retained on 10mm sieve known as course aggregate. The particles passing through 4.75mm sieve are called as quarry dust. The quarry dust is used to manufacturing of hollow blocks. The program involves casting and testing cube specimens in each set consisting of 3 cubes. The cubes were casted using standard cubes of 150 mm × 150 mm × 150 mm. Specific gravity of sand and quarry dust of 2.62 and 2.70. 53 grade cement is used for the mix. Curing was done by conventional moist curing for the concrete mix. Compression testing machine of 2000 KN capacity was used to test the cubes' specimens. The set of series are, M20 & M25 grade of concrete with 10, 20, 30, 40, 50 and 60 percentage replacement of quarry dust tested for 7 days, and 28 days is studied and the results are presented.

3.2 Workability Test(Compaction Factor Test)

The variation of workability is measured in terms of compaction factor with constant w/c ratio (0.44). The values are obtained for different mixes such as M1 (0% quarry dust), M2 (20% quarry dust), M3 (25% quarry dust), M4 (30% quarry dust), M5 (35% quarry dust) are 0.83, 0.85, 0.86, 0.88, 0.91 respectively.

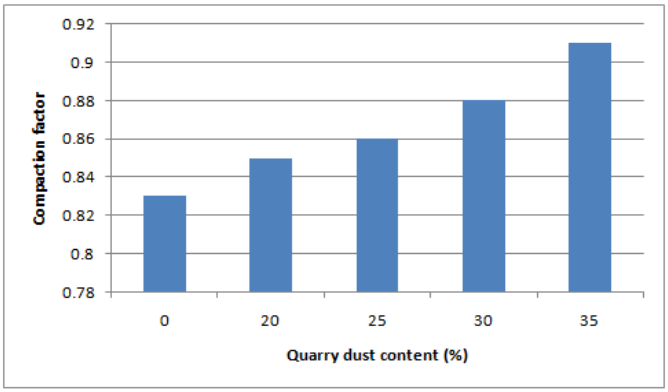
4. Discussion on Result

4.1 Result of Compressive Strength Test

Table 1: Mean Compressive strength of concrete (N/mm²)

Sand: Quarry dust	M20		M25	
	7 days	28 days	7 days	28 days
90:10	19.58	22.62	23.58	30.14
80:20	20.3	23.98	23.96	30.55
70:30	20.88	25.32	24.11	31.14
60:40	21.27	25.67	24.18	31.53
50:50	22.62	26.55	24.68	31.91
40:60	20.43	26.21	23.59	31.32
30:70	19.24	23.55	23.36	30.86
20:80	18.14	22.21	20.57	30.23
10:90	17.69	20.88	20.34	29.32
00:100	15.84	21.43	19.66	28.32

4.2 Result of Compaction Factor Test



5. CONCLUSION

All the results and data shows that the quarry dust is a suitable for alternative of natural sand in concrete.

The results of compressive strength test shows that 50% replacement of sand by quarry dust gives higher value of compressive strength and 100 % replacement of sand by quarry dust also gives better result than natural sand concrete.

The result of workability test shows quart dust concrete is more workable than sand concrete.

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