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 compressive strength of Quarry Dust as fine aggregate in concrete

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**Abstract -** *The concept of replacement of sand by quarry dust which is highlighted in the study could boost the consumption of quarry dust generated from quarries. By the replacement of quarry dust, reduce the requirement of land fill area and can also solve the problem of natural sand scarcity. Sand availability at low cost as a fine aggregate in concrete is not suitable and that is the reason to search for an alternative material. Quarry dust satisfies it behind the alternative material as a substitute for sand at very low cost. It even causes burden to dump the crusher dust at one place which causes environmental pollution. From the results of experimental investigations conducted, it is concluded that the quarry dust can be used as a replacement for fine aggregate. It is found that 50% replacement of fine aggregate by quarry dust gives maximum result in strength than normal concrete and then decreases after replacement of fine aggregate. .*

***Key Words***: fine aggregate, quarry dust, compressive strength, replacement.

## 1. INTRODUCTION

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. Therefore, quarry dust should be used in construction works at various percentage i.e. 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100 percent which will reduce the cost of construction and the construction material would be saved and the natural resources can be used properly, So it becomes a useless material and also results in air pollution.

This study is planned to study the effects of quarry dust addition in normal concrete and to assess the rate of compressive strength development. The work mainly deals with the influence of different replacement proportion of sand with quarry dust on the properties of concrete.

## 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

Quarry dust is a result of crushers while doing quarrying activities. 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 is M20 grades of concrete with10, 20, 30, 40, 50, 60, 70, 80, 90 and 100 percent replacement of quarry dust with water-cement ratio of 0.45 are studied and the results are presented.

## 4. Discussion on Result

(a) The compressive strength results of quarry dust concrete (cubes) were obtained where M20 grade of concrete with 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100 percent replacement of quarry dust tested for 7 days, and 28 days is studied and the results are presented. The specimens were casted with conventional materials; that is, fine aggregate is natural river sand with M20 grade by using ordinary Portland cement (OPC).

With the increase in age of concrete, the compressive strength increases up to 50 percent replacement of quarry dust as a fine aggregate. The partial replacement of quarry dust gave a 28 days' peak compressive strength at 50% replacement level. Figure shows the compressive strength of M20 grade with varying age of concrete by replacement level up to 50%.

The compressive strength results of quarry dust concrete (cubes) were obtained where M20 grade of concrete with 10 percent increment up to 100 percent replacement of quarry dust is concentrated and the results are presented.

The study aimed to observe the compressive strength properties of quarry dust by varying full percentage replacement. The results show increase in strength up to 50 percent level and then an onwards decrease in compressive strength with change in age for M20 grade of concrete. Figure shows the compressive strength of varying age of concrete by 100 percent replacement of quarry dust.

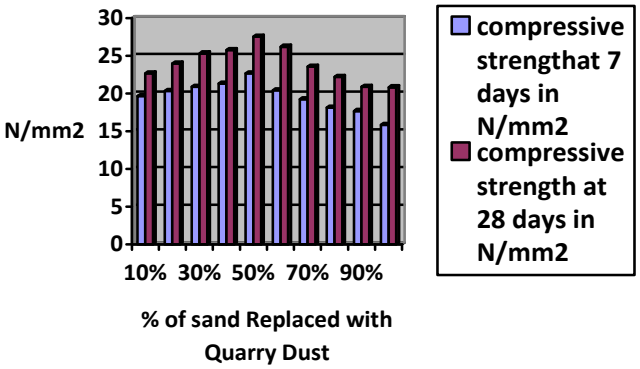


Figure : Compressive strength of 7, and 28 days for M20 grade up to 100% replacement of quarry dust.

## 5. CONCLUSIONS

The concept of replacement of natural fine aggregate by the quarry dust could improve the utilization of generated quarry dust, thus reducing the requirement of land fill area and conserving the scarcely available natural sand sustainable development. Strength of the concrete is mainly dependent on bonding of the fine aggregates which fills the voids between the coarse aggregates.

From the experimental study, it is concluded that the quarry dust can be used as a replacement for fine aggregate. It is found that 50% replacement of sand by quarry dust gives maximum result in strength compared to normal concrete and then decreases from 50%. The results proved that up to 50% replacement of sand by the quarry dust induced higher compressive strength and the workability of concrete decreases as replacement increases. Thus the environmental effects and waste can be significantly reduced.

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