ABSTRACT

Concrete as construction material has the largest production of all materials used in construction. This is produced ten billion tonnes every year and it stands next to the total consumption of water. Conventionally, concrete is a mix of cement, sand and coarse aggregate. In our environment, transportation and other constraints make the availability and use of natural sand as fine aggregate less attractive. So a substitute or replacement product for the concrete needs to be found.

Most of the aggregate crushing plants in India adapt crusher equipment by trade name JAW, Cone, VSI crusher incorporating rock–on–rock crushing technology. These crushing machines produce quarry rock dust as a byproduct, 12-15 percent of crushed stone at every crushing plant produced.

Quarry rock dust formed by screening products at second and subsequent stages of crushing igneous rock, sedimentary rock or gravel, can be classified as coarse sand since particle size lies between 0-4.75 mm. About 200 million tonnes of quarry dust is available in India at present. So, its effective utilization is important. Its usage in cement concrete however, has not been well investigated.

Common river sand is expensive due to excessive cost of transportation from natural sources. Large-scale depletion of these sources creates environmental problems. In such a situation, quarry rock dust can be an economic alternative to the river sand.
Quarry rock dust can be defined as residue, tailing or other non-voluble 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 highway as a surface finishing material and is also used for manufacturing of hollow blocks and lightweight concrete prefabricated elements.

The purpose of this research is to find the suitability of quarry rock dust as alternative material for the river sand with hundred percent replacements.

The experimental studies were divided into aggregate tests for determining the aggregate characteristics and concrete tests. The tested aggregates were used for concrete production and observation of behavior of fresh and hard concrete properties.

This study presents the characteristics of quarry rock dust in terms of physical properties and chemical composition to ascertain the effects. Quarry rock dust is obtained from a single source. The variability is also studied in natural sand.

Further, this study also presents the feasibility of the usage of quarry rock dust as hundred percent substitute for natural sand in plain concrete. Mix design has been developed for three grades (M20, M30, M40) using design of an approach IS, ACI, USBR, Road Note No.4 and British for both conventional concrete and quarry dust concrete.
Another mix design with Indian standard has been developed for the above three grades to investigate the effect of aggregate size (10, 20, 40 mm) on quarry rock dust concrete and conventional concrete.

Tests were conducted on fresh concrete to study the workability properties made of quarry dust concrete and natural sand concrete. Tests were also conducted on cubes, prisms, cylinders and RC beams to study the strength of concrete made of quarry rock dust and the results were compared with the natural sand concrete. It has further been attempted to find durability of quarry rock dust concrete when it is compared with natural sand concrete.

The loss of workability, which may occur due to high water absorption, fine state, flaky graded and rough textured, can be restored by suitable screening and washing techniques and different types of superplasticisers and change in water content using mix proportional approach.

It is found that the strength and durability studies of concrete made of quarry rock dust are nearly 10% more than that of the conventional concrete. It may be 15-20% higher silica content in quarry rock dust. The comparison for cost factor shows that the cost required for quarry rock dust is 10 percent less even after considering cost of superplasticisers and increased cement content.

A real case study was undertaken to adopt the findings in the construction sites for which simple methods of concrete mix proportioning and method of washing are incorporated.