Experimental Study on Granite Powder as a Replacement of Fine Aggregate in Concrete

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ABSTRACT

Throughout the world as a result of growth in infrastructural development and consequent increase in consumption has led to a fast decline in available natural resources. In contrast the ornamental granite production has produced enormous amount of by-product in the form of fine particles as a result all the construction and environmental industry concerned about the disposal of those million tons of fine materials. The main objective of this study is to experimentally investigate the suitability of granite powder by-product as a substituent material for fine/natural aggregate in concrete production. This paper presents the physical and chemical characterization of the GP by-product as well. The experimental parameters were grade of concrete and percentage of granite powder substition. The cubes are prepared by 0%,10%,15%,20% of fine/natural aggregate substation GP by-product on behaviur of concrete, compressive strength on cubes are perform. Experimental results revealed that compressive strength and axial stress strain behaviour of the substition rate upto 20% is fairly greater than values obtained with natural aggregates and it is suggested that substition of natural aggregates by GP by-product upto 20% is favourable for the concrete resistance.

I.INTRODUCTION

The engineers are constrained to implement new materials and techniques to efficiently develop the conventional concrete. Although throughout the world, all the construction and environmental industry concerned about the increasing volume of industrial waste in the form of solid, liquid and gaseous.

Among the 25 states in India, Tamilnadu state has the 70% of total granite reserve. Using different types of cutting methods, granite stones are machined from the quarries and the blocks are transported to nearby processing plants.

This granite is the strongest of all the materials which is used for construction and now this is used for concrete in the form of powder as a partial replacement for natural sand.Then the stones are industrially processed such as sawing and polishing, finally processed stones are used to decorative purposes and economically valuable. During this industrial process the fine granite and water mixed together and become a granite colloidal waste by product.

After being air dried, the by-product became a dry mud consisting of very fine powder. During the cutting process 20 to 30 % of granite block became dust. Performance of the recycled aggregates concrete was measured through testing of density, air content, workability and compressive and tensile strength. The use of alternative both fine and coarse aggregate has become necessity for the construction industry because of the economic, environmental and technological benefits derived from their use.

In developing countries, where abundant agricultural and industrial wastes are discharged, these wastes can be used as potential material or replacement material in the construction industry. This will have the good advantage of reduction in the cost of construction material.

II. LITERATURE REVIEW

2.1 GENERAL

In order to reduce the dependence on natural aggregates as the main source of aggregate in concrete, artificially manufactured aggregates and artificial aggregates generated from industrial wastes provide an alternative for the construction industry. Some alternative materials have already been used in place of natural river sand. For example, fly ash, slag and lime stone, siliceous stone powder, rock dust and quarry waste were use dim concrete mixture as a partial replacement of natural sand. Granite powder, one of the by-products in granite stone crushing process, not being used for any applications other than filling up low lying areas is identified as a replacement material for river sand in concrete. The various literature works collected on the study of the behavior of concrete with use of granite powder has been reviewed and relevant literature has been presented in this chapter.

K. Chairanjeevi Reddy "Experimental study on concrete with waste granite powder as an admixture" (June 2015), Granite fines are used as a filler material in the concrete, replacing the fine aggregate which will help in filling up the pores in the concrete. Filling up of the pores by granite fines increase the strength of the concrete and also a material which is abundantly to investigate the strength behavior of concrete with use of granite fines as an additive. From workability of concrete it is observed that the compaction factor values and slump test are decreasing from 0to 10% replacement of cement by granite powder. The granite fine particles are compatible with purpose of filling up the transition zone and capillary pores, thus acting as micro filler.

Divakar "Experimental investigation on behavior of concrete with use of granite fines" (Sep 2012), In this paper an attempt is made experimentally to investigate the strength behavior of concrete with the use of Granite Fines as an additive. Various tests such as compressive strength, split tensile strength and strength and Flexural strength are investigated and these values are compared with the conventional concrete without granite fines. Hardened concrete specimens includes compressive test on concrete cubes, Split tensile test on concrete cylinders and Flexural Strength test on cement concrete prisms and reinforced concrete beams specimens. The dimension of the granite fine particles is compatible with the purpose of filing up the transition zone and capillary pores, thus acting as micro filler. Some alternative materials have already been used in place of natural river sand. For example, fly ash, slag and lime stone, siliceous stone powder, rock dust and quarry waste were use dim concrete mixture as a partial replacement of natural sand

Dr. T. Felixkala "Effect of granite powder on strength properties of concrete" (Mar 2010), Examines using granite powder replacement of sand and partial replacement of cement with fly ash, fumes and slag in concrete. The percentage of granite powder added by weight was 0,25,50 75 and 100 as a replacement of sand used in concrete and cement was replaced with 7.5% silica fume, 10% fly ash, 10% slag and 1% superplasticiser. The compressive strength of granite powder concrete was increased when admixtures were used. The test results obtained indicate that granite powder of marginal quantity as partial sand replacement has beneficial effect on the mechanical properties such as compressive strength, split tensile strength, modulus of elasticity. Furthermore, the test results indicated that the values of both plastic and drying shrinkage of concrete in the granite powder concrete specimens were nominal than those of ordinary concrete specimens. Granite powder, one of the by-products in granite stone crushing process, not being used for any applications other than filling up low lying areas is identified as a replacement material for river sand in concrete

Only insignificant quantities have been utilized and the rest has been dumped resulting in environmental problems. Presently, all the processing units are disposing this industrial waste by dumping it in open yards, that nearly occupying 25% of the total area of the industry

Shahul Hameed M, "Properties of Green Concrete Containing Quarry Rock Dust and Marble Sludge Powder as Fine Aggregate" (June 2009) , investigated the usage of quarry rock dust and marble sludge powder as possible substitutes for natural sand in concrete. They also carried out durability studies on green concrete and compared with the natural sand concrete. They found that the compressive, split tensile strength and the durability concrete were good when the fine aggregate was replaced with 50% marble sludge powder and 50% Quarry rock dust (Green concrete). The resistance of concrete to sulphate attack was enhanced greatly.

R. Hangovana, "Strength and durability properties of concrete containing quarry dust as fine aggregate" (Oct 2008), The Durability of Quarry Rock Dust concrete under sulphate and acid action is higher inferior to the conventional concrete. Permeability Test results clearly demonstrates that the permeability of Quarry Rock Dust concrete is less compared to that of conventional concrete. The water absorption of Quarry Rock Dust concrete is slightly higher than Conventional Concrete Therefore; the results of this study provide a strong

support for the use of Quarry Rock Dust as fine aggregate in concrete Manufacturing. Thus, it can be conclude that the replacement of natural sand with Quarry Rock Dust, as full replacement in concrete is possible.

The reduction in waste generation by manufacturing value added products from the granite stone waste will boost up the economy of the granite stone industry**2.3 REVIEW OF LITERATURE**

III.PROPERITIES OF MATERIALS

Cement, fine aggregate, coarse aggregate, Spent fire bricks waste are the various materials used in this project. The main constituent of this project include cement, fine aggregates, coarse aggregates in addition to other materials such as granite powder. Before casting the specimens a study has been carried out by conducting various tests on the material

3.2 STUDY OF MATEIALS

CEMENT

Cement is defined chemical entity formed from predetermined ratios of reactants at a fairly precise temperature.Cement is obtained from limestone (calcium carbonate) and small quantities of other materials (such as clay) through a heating process in kilns, the process known as Calcinations. The resulting hard substance, called 'clinker', is then ground with a small amount of gypsum to form Ordinary Portland Pozzolana Cement also referred as PPC. This forms a basic ingredient of concrete, mortar, grout etc. and its most common use is in the production of concrete. Concrete is a composite material which consist of cement, aggregates (both coarse [gravel] and fine [sand]), and water. It has a wide application in the construction industry since it can be cast and molded in any desired shape. After it hardens, it can be effectively used for load bearing structures.

b)FINE AGGREGATES

Fine aggregate consist of mainly sand which may be natural, manufactured or a combination of both. It consists of clean and durable particles generally spherical or cubical in shape. The use of flat or elongated fine aggregate particles should be restricted and also care should be taken to ensure that there are no contaminating substances - dirt, dust, mud, and construction debris - present in fine aggregates. Fine aggregates particle size varies from 0.075 to 0.425 mm. The specific gravity of sand is 2.5.

c) COARSE AGGREGATE

Coarse aggregates consist of aggregates larger than fine aggregates and their sizes vary from 20 to 4.75mm. These tend to improve quality and bond characteristics and generally results in a higher flexural strength of concrete. It also helps in reducing shrinkage. These aggregates occupy 70-80% of volume of the concrete. The specific gravity of sand is 2.7.

d) Granite powder dust

Fineness modulus and specific gravity of the granite powder are 2.43 and 2.58 respectively. Sieve analysis was carried out for granite powder and compared with sand; the amount of fine particles present in granite powder is considerably higher when compared to the river sand. Its size was less than 90 microns

e)WATER

Water for construction of concrete structure should be same quality as drinkable water. The
strength of concrete is totally depend upon the water thus water should be free from impurities. Impurities like suspended solids, dissolved salts organic matter. Which affect properties of concrete. These impurities can be changed setting time, hardening, strength, durability and etc. Water should be tested from an approved lab and should be checked
regularly and pH value of water is 7.

IV MIX DESIGN OF CONCRETE FOR M20

Design mix of concrete for 25 grade are made as per IS 10262: 2009. Water cement ratio and minimum cement content is taken as per IS 456: 2000 (Table 5).

Size of nominal maximum of aggregates is 20 mm used. Minimum water content as per IS 10262: 2009.

V TESTING OF MATERIALS

SPECIFIC GRAVITY TEST:

Specific gravity of fine aggregates is found to be 2.5. And as per IS 2386 (part3):1963, the specific gravity of coarse aggregate should be 2.2 to 3.2.

SIEVE ANALYSIS TEST:

Fineness modulus of Fine Aggregate is 4.82%.The soil belongs to zone II of classification (IS383).

WATER ABSORPTION TEST

% of water absorption of fine aggregate = 1.2%.

SPECIFIC GRAVITY TEST:

Specific gravity of coarse aggregate is found to be 2.71 and as per IS 2386 (part3):1963, the specific gravity of coarse aggregate should be 2.6 to 2.9.

SIEVE ANALYSIS TEST:

Fineness modulus of Coarse Aggregate is 5.18%.The soil belongs to zone II of classification (IS383).

WATER ABSORPTION TEST:

% of water absorption of coarse aggregate = 0.72 %

VI RESULT

1 GENERAL

The values obtained for Compressive Strength of cubes are tabulated. Comparisons are made and are presented in this chapter.

8.2 COMPARISON OF RESULTS

a) COMPRESSIVE STRENGTH OF CUBES

The values obtained from the compression test on cubes (28^{th} day) are tabulated. Graphs are plotted for compressive strength vs. % adding for waste SFB. Further satisfactory results are obtained for 0%, 10%, 15%, 20%.

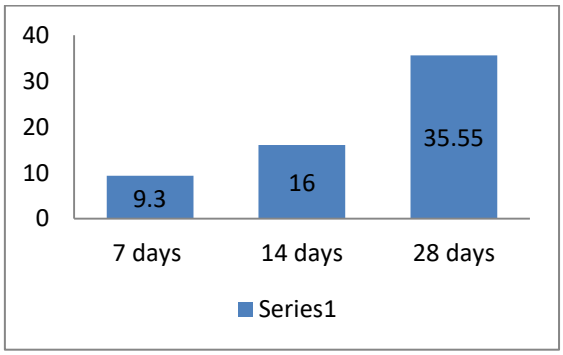

Fig : 20% of granite powder

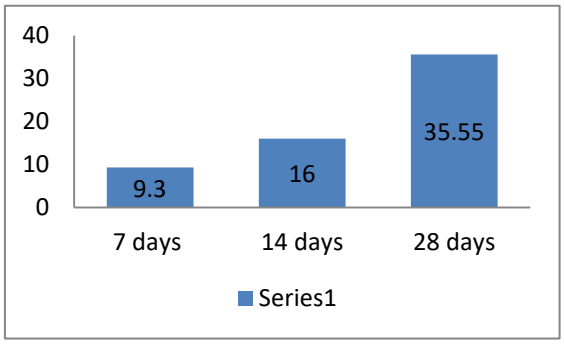

Fig : 10% of granite powder

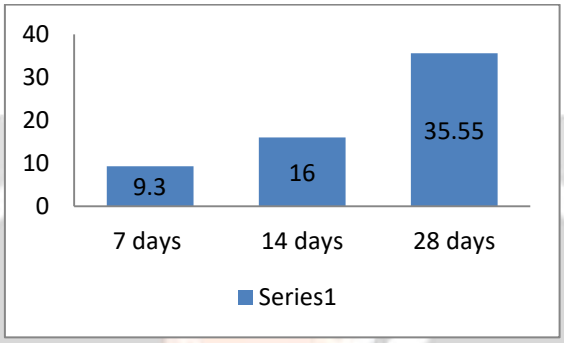

Fig : 15% of granite powder

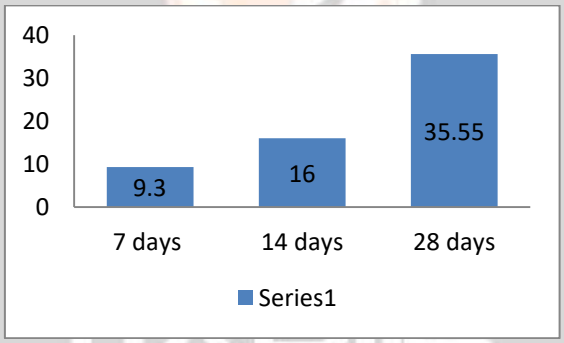

Fig : 0% of granite powde

V II CONCLUSION

- A lot of benefits are derived by management of industrial waste, some of which are conservation of raw materials in term of cost and environmental preservation.
- Compressive strength of HPC shows increasing trend till 15% increment of granite powder and again it was very near to the conventional concrete. The workability of concrete is good even after addition of the granite powder as replacement into concrete.
- The current experimental work shows that the strength properties of the concrete could be enhanced by utilization of granite powder in concrete are the best choice, where they are available.
- Hence the granite aggregates can be considered as an alternative for the fine aggregates (river sand).

VIII. REFERENCES

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