STUDY OF GRANITE POWDER AS CEMENT REPLACEMENT WITH FIBRE REINFORCED CONCRETE

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Abstract *Granite powder is one of the most active research element that influence a number of construction activities including civil engineering and construction materials. In India granite stone dust settled by sedimentation and then dumped away which results in environmental pollution, in addition to forming dust in summer and threatening both agriculture and Public health. Therefore, utilization of stone dust in various industrial sectors especially the construction, agriculture, glass and paper industries would help to protect the Environment. It is most essential to develop eco- friendly concrete from stone waste. In this research study the cement has been replaced by granite stone waste accordingly in the range of 0%, 5%, 15%,& 20% by weight for M20 grade concrete. Concrete mixture was tested and compared in terms of workability and strength to the conventional Concrete. These tests were carried out to evaluate the mechanical properties for 7 and 28 days. Along with this concrete mixes constant 1% and 2% of admixture galvanized steel is used as fibre and again compared with conventional concrete.*

Index Terms: Granite, Galvanized fibre, workability.

INTRODUCTION

Concrete is compound and homogeneous material that is compound mainly of water, aggregate and cement. In general additives and reinforcements are included in the mixture to get the desired physical properties of the finished material. When the ingredients mixed together, they form a fluid mass that can be simply mould into the required shape. Over time goes on, the cement form a hard matrix which binds the rest of the ingredients into a durable stone like material so with many uses.

Concrete has been a leading construction material for over a century. Its annual global production is about 3.8 billion m^3 - roughly 1.6 tonnes per capita which is from Portland Cement Association. For the last few years, great emphasis was chosen on green concrete as the results of sustainable development. Green concrete is implies by an application of industrial wastes to reduce consumption of natural resources, to save energy and minimize pollution in environment. In the various varieties of industrial wastes produced the marble or granite wastes, having potentiality in utilisation as the one of the element in the concrete.

These wastes can be used as a filler material to reduce the total voids content in concrete and pozzolonic material like as cement in the concrete as mix while containing its of the physical and mechanical properties. Granite or marble waste is an industrial waste which obtain from the granite industry in a powder form. As from the data total waste from these industries in this region may be approximately 2100 Tonnes per week. This waste is easily carried away by the air and hence causes problems to human beings as in case of health and environment.

With the greater increase in the quantity of waste disposal, coupled with shortage of dumping sites, increase in the transportation and dumping costs the quality of environment, has got seriously deteriorated preventing sustainable development. As granite powder waste (GPW) is a very finer material, it will easily carried away in the air and it causes nuisance causing health problems and also environmental pollution. Granite powder waste (GPW) is a fine material; it gets easily carried away by air and causes nuisance and health problems as well as environmental pollution.

The major effects of air pollution are lung diseases and inhaling problems with the majority of people living in and around being affected the worst. In this present work, GPW to cement. To find in this investigation have used

granite waste as partial replacement to different percentage the compressive strength, split tensile strength and flexural strengths of concrete have been determined. By doing so, the objective of reduction of cost construction can be met and it will help to overcome the environmental problem associated with its disposal including the environmental problems of the region

LITERATURE STUDIES

Abukersh.S et al studied on „Recycled aggregate concrete produced with red granite dust as a partial fine aggregate replacement.“The experimental test results showed that the use of granite dust at 20 to 50% level reduces significantly the concrete compressive strength and had little negative effects on concrete tensile strength.

M.S. Jaafar et al made study on „Strength and durability characteristics of high strength autoclaved stone dust concrete.“ The study focused on the effect of using fine stone dust as cement replacement on the mechanical properties as well as durability characteristics in high strength concrete. 30% of the OPC was replaced by fine stone dust having 95% purity of silica. The result of the study indicated that high strength concrete can be produced using fine stone dust with improved strength and durability.

MATERIALS AND MIX RATIOS USED

Cement

Ordinary Portland cement of 53 GRADE was used.

Fine aggregates

Generally near accessible pit sand, which is passing through 4.75mm I.S sieve, was used.

Sample of fine aggregates

Natural coarse aggregates

Natural granite aggregate which is accessible in the local sources has been used during this study all-in-all size coarse aggregate which passing through the 20mm IS sieve and retained in the 10mm IS sieve has been used for the effective utilization and smart inserting of coarse aggregate. It is very essential to know the specific gravity, density and water absorption of the coarse aggregate in order to determine the mix proportions of the concrete.

Sample of coarse aggregates

Water

Fresh potable water which is free from concentration of organic and acidic substances has been in this experimental investigation for mixing the concrete.

Granite powder

The word granite comes from Latin word Granum, a grain, in reference to coarse grained structures. Granite is a igneous rock with at least 20% quartz and 65% alkali feldspar by volume. The specific gravity of granite powder is between 2.6 to 2.9.It is a good frost resistant and low fire resistant.

Sample of granite powder

Fibers

Galvanized iron fibers of aspect ratio 30 used in this study. Cross sectional dimensions of this typical galvanized iron fiber of diameter of 1.0mm wire cut into required length of 3cm, which are created in various from of geometry. Steel fibers were produced in steel sheet from, through the process of cutting steel sheets.These galvanized iron (or) steel fibers is commercially available and generally used for electrical work. These fibers are commercially available in the market.

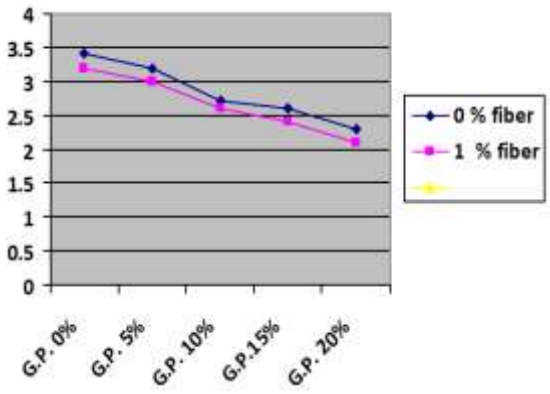
Sample of galvanized steel fibres

NOMENCLATURE

1. **GP – 0 (CONVENTIONAL)** Here GP refers granite powder, '0' refers to % replacement of cement with granite powder.
2. GP-5 Here GP refers granite powder, '5' refers to % replacement of cement with granite powder.
3. GP-10 Here GP refers granite powder, '10' refers to % replacement of cement with granite powder.
4. GP-15 Here GP refers granite powder, '15' refers to % replacement of cement with granite powder.
5. GP-20 Here GP refers granite powder, '20' refers to % replacement of cement with granite powder.
6. GP-0-1 Here GP refers granite powder, '0' refers to % replacement of cement with granite powder, '1' refers to constant 1% of fibres
7. GP-5-1 Here GP refers granite powder, '5' refers to % replacement of cement with granite powder, '1'refers to constant 1% of fibres.
8. GP-10-1 Here GP refers granite powder, '10' refers to % replacement of cement with granite powder, '1' refers to constant 1% of fibers.
9. GP-15-1Here GP refers granite powder, '15' refers to % replacement of cement with granite powder, '1' refers to constant 1% of fibers
10. GP-20-1Here GP refers granite powder, '20' refers to % replacement of cement with granite powder, '1' refers to constant 1% of fibre

RESULTS AND ANALYSIS

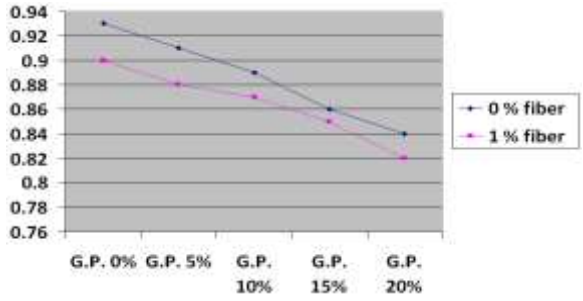
Slump cone test results



Comparison of slump cone values

The slump test expresses improving trend when percentage replacement of cement with granite powder increased. The height for concrete consist of no fibres and 1 % of fibres.the empirical results expressed that the slump value of fibre reinforced concrete has a declining trend when fibres volume percentage increases. The below figure expresses that workability of concrete mix Improves as percentage of fibres rate increases.

Compaction factor test results



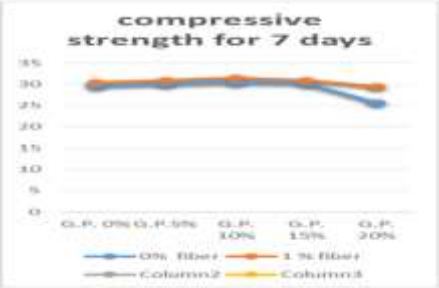
Comparison of compaction factor values

Similar to the slump test, the compaction factor test expresses improving trend when percentage partial

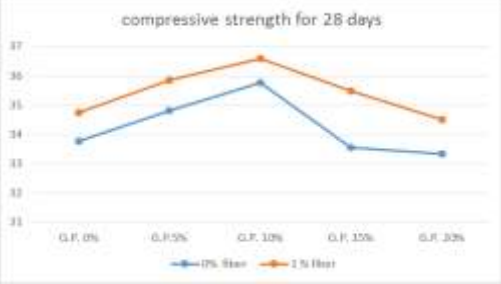
replacement of cement with Granite powder increased. compaction factor value for concrete consist of no fibres and 1% of fibres.

The empirical results showed that the compaction factor value of the fibre reinforced concrete has a declining trend when fibres volume percentage rate increases. The workability of concrete mix improves as the percentage fibre rate increases.

Compressive strength

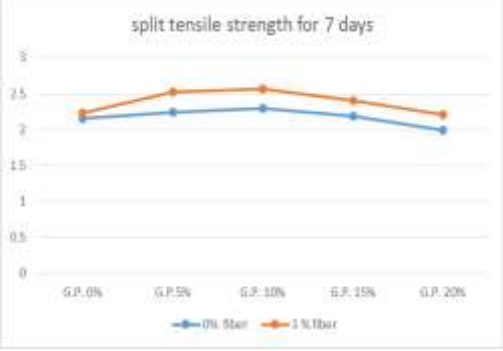


Percentage replacement vs Compressive strength for 7 days

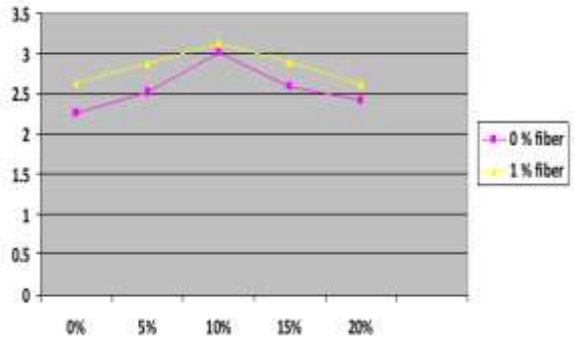


Percentage replacement vs Compressive strength for 28 days

Split tensile strength



Percentage replacement vs split tensile strength for 7 days



Percentage replacement vs split tensile strength for 28 days

CONCLUSIONS

1. The Compressive strength of Cubes are increased with addition of granite powder up to 10% with +5.92% and further any addition of granite powder the compressive strength decreases till 20% with -1.3%. Addition of 1% fibres improves the compressive strength value of concrete +6.32%.
2. The Split Tensile strength of Cylinders are increased with addition of granite powder up to 10% with 33.18% and further any addition of granite powder till 20% the Split Tensile strength decreases with +7.07%.Addition of 1% fibres improves the split tensile strength value +36.38%.
3. Workability of concrete mix decreased with replacement of cement with granite powder. But up to some extent even replaced concrete mixes got optimum results. Addition of fibres decreases the workability properties of mix even it replaced with Granite Powder.
4. Thus we found out the optimum percentage for replacement of granite powder and fibre with cement and it is almost 10% cement for both cubes and cylinders.
5. By considering all the above parameters like slump cone value, compaction factor value, compressive strength and split tensile strength, it is concluded that it is better to limit the replacement level of “Granite Powder up to 10%” only.
6. Failure pattern of cube specimens and cylindrical specimens is almost similar to all mix batches.

7. We have put further a simple step to minimize the costs for construction with usage of Granite Powder which is freely or cheaply available.
8. We have also stepped into a realm of saving the environmental pollution by cement production being our main objective as Civil Engineers.

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