Experimental Investigation on Cement Concrete with Partial Replacement of Sand by Waste Granite Powder

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Abstract

In modern days concrete made with cement is probably the most widely used artificial material in the world. Despite this fact, concrete production is one of the concerns worldwide that impact the environment with a huge impact being global warming due to carbon dioxide emission during the production of portland cement. On the other hand, when industrial wastes are recycled or reused, Carbon dioxide(CO_2) emissions are reduced and a small amount of material is dumped in a landfill and natural resources are saved. Therefore an attempt is made to replace the cement with granite powder in concrete. In this study, the possibility of using granite powder with cement on the performance of fresh and hardened concrete. In this experimental study, granite powder is used in concrete as cementitious material a partial replacement of cement. The replacement of cement was made by the level of 6%, 12%, and 20% by weight of cement. For each replacement, a compressive strength test was conducted. Compressive strength after 7days, 14days, and 28 days curing was done. From the test results, it was found that concrete at the level of 20% partial replacement of cement with granite powder had better workability and strength of 14 days and 28 days curing. The granite powder is available easily and is free of cost. So it seems to be economical.

Keywords: Artificial materials, Global warming, Granite powder.

I. INTRODUCTION

Going away from the waste materials to the general condition directly can cause conditions hard question for this reason the use again of waste material has been emphasized. Waste can be used to produce new products or can be used as admixtuires so that natural resources are used more with small amount of support and the general conditions is kept safe from waste money put in bank. It is put a value on that stone-like paste producing is responsible for about 3% of the complete anthrogenic greenhouse gas emission and for 5.25% of the complete anthrogenic C_{O2} emission. As about 50.48% of the CO_2 given out during stone like building paste producing is related to the breakdown of limestone during burning, mixing is taken into account as a very working well way to get changed to other from CO_2 emission.

The move-forward of common building material technology can get changed to other form the using up of natural resources and powder for a given time starting points and make less the weight down of pollutants on general condition. Presently greatly sized amounts of granite powder are produced in natural stone processing plants with an important force of meeting blow on general condition and humans. This undertaking gives a detailed account of the able to be done of using the granite thick, soft, wet mix of the

liquid and solid parts dust in common building materials producing as not complete, in the part putting in place of stone-like building paste.

In India, the granite and granite stone processing is one of the most getting on well industry the effect if changing granite dust what is in on the physical and machine-like properties of newly produced and hardened common building material have been made observation. Most common materials used in stone-like building paste producing added in plant or sites are to do with industry wastes. This is because of, in relation to the fact that making use of again to do with industry wastes as mixing materials has special to some science or trade, money-related and conditions benefits in addition to the moving a lower level of co_2 emission from stone-like building paste producing granite powder which is a side-effect of granite processing building in which goods are made was studied by many persons making observations for its use in common building material and army fighting device producing as sand giving another in place of or stone-like building paste giving another in place of material.

Granite power is obtained from the crusher units in the form of finer fraction. The highest compressive strength was achieved in samples containing 40% granite power. This is a physical mechanism owing to its spherical shape and very small in size. granite powder dispenses easily in presence of superplasticizer and fills the voids between the quarry sand, resulting in a well packed concrete mix .Granite power can be used filter as it helps to reduce the total voids content in concrete. Granite powder and quarry rock dust improve pozzolanic reaction. The quarry rock dust and granite powder can be used as 100%substitutes for natural sand in concrete. The compressive split tensile and durability studies of concrete made of quarry rock dust nearly 15% more than the conventional concrete. The concrete resistance to sulphate attack was enhanced greatly.

The combination of pozzloanic and filler action leads to increase in compressive and split tensile strengths, reduction in bleeding and segregation of fresh concrete, reduction in permeability, reduction in alkali silica reaction, reduction in sulphate attack, chemical attack and corrosion attack, leading to increased durability and reduction in heat of hydration. From the test, specific gravity of the fine aggregate 2.65 was obtained.

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K. ShyamPrakash and Ch. HanumanthaRao , et. al, 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 40% replacement of fine aggregate by quarry dust gives maximum result in strength than normal concrete and then decreases from 50%. The compressive strength is quantified for varying percentage and grades of concrete by replacement of sand with quarry dust. Ravindra Nagar, Vinay Agrawal, Aditya Rana, Anshuman

Tiwari, et. al, study investigates the feasibility of using granite cutting waste (GCW) as a partial substitute of river sand in high strength concrete based on strength, durability& micro structural attributes at 0.30, 0.35 and 0.40 water cement ratios (w/c) by substituting 0%, 10%, 25%, 40%, 55% and 70% river sand by GCW suggested that 25–40% river sand can be substituted by the GCW with a favourable influence on the investigated parameters. The optimum amount of GCW to be used in concrete depends significantly upon water-cement ratio of concrete. Pradeep K. Goyal et. al study is conducted to investigate the viable use of marble granite residue (MGR) in concrete mixes. Sand is replaced with GD along with cement (OPC grade 43) is replaced with MP as 0%, 10%, 20%, 30% & 40% by weight for M25 grade of concrete.

Joseph O. et al., (2012) concluded that the flexural and tensile strength properties were found to compare closely with those for normal concrete. Hence, concrete with mixtures of lateritic sand and quarry dust can be used for structural construction provided the proportion of lateritic sand content is kept below 50%. Both flexural and tensile strengths were found to increase with increase in laterite content. Further work is required to get data for long-term deformation characteristics and other structural properties of the experimental concrete. These include: shear strength, durability, resistance to impact, creep, etc. Also, it may be necessary to investigate the optimum contents of lateritic sand and quarry dust in relation to the structural properties of the concrete. These will assist engineers, builders and designers when using the materials for construction works.

Figure1. Waste Granite Powder

Table.1 Physical Properties of Granite Powder

S.No	Specification	Values
	Specific gravity(g/cc)	2.77-2.82
	Density (Ibs/ft3)	166.5
	melting point (^{0}F)	Approx 3,000
	Solubility in water	Insoluble
	Boiling point (^{0}F)	Approx 4,000
	Oder and Appearance	Black and white speckled rock no odder
	Mohrs Hardness	7.0
	Vapor Pressure	None
	Thermal Conductivity (K)	~ 2.2
.	Particle Shape	Irregular
.	Color	Pink, light gray, dark gray

II. MATERIALS USED

1. Cement-ULTRATECH brand, OPC 53 grade cement was used.
2. Fine Aggregate-River sand from kollidam river bed were used.
3. Coarse Aggregate-Hard blue granite of size 20 mm and 12.5mm was used. The aggregate is in the shape of angular.
4. Water-The tap water having the pH value satisfying the I.S.CODE was used.
5. Granite powder-Granite dust powder obtained from the Granite factory at Mannargudi.

III. MIX DESIGN

Based on the physical properties of material and tested as per IS: 4031-1996, IS: 383-1970, M20grade concrete mix was designed as per IS: 10262-2009.Mix proportion and its details are shown in table 2 and 3.

Characteristics compressive strength required in the field at 28 days = 20Mpa

Maximum size of aggregate (angular) = 20 mm

Degree of workability (compaction factor) = 0.90

Degree of quality control = Good

Type of exposure = Mild

Specific gravity of cement = 3.159

Specific gravity of coarse aggregate = 2.70

Specific gravity of fine aggregate = 2.631

Water absorption of coarse aggregate = 1.8%

Water absorption of fine aggregate = 1%

Free moisture of coarse aggregate = 0 %

Free moisture of fine aggregate = 2%

Table 2. Mix Proportion

Water	Cement	Fine Aggregate	Coarse Aggregate
0.55	1	1.55	3.18

Table 3. Details of Mix Proportioning

Mix	Details of mixing
O	1: 1.55: 3.18: 0.55
WGP1	R – 5% Cement+ 6% Granite powder
WGP2	R – 10% Cement+ 12% Granite powder
WGP3	R – 20% Cement+ 20% Granite powder

IV. TESTS CONDUCTED

Workability test and strength test were conducted for fresh concrete and compressive strength test was conducted for 7 days 14 days and 28 days curing.

V. TEST RESULT AND DISCUSSION

A. Slump Cone Results

From the slump cone and compaction test results shown in table 4, it is found that GD3 has higher slump and compaction factor values.

Table 4.Slump and Compaction Factor values

Mix	Slump value in mm"	Compaction Factor
O	54	0.920
WGP1	74	0.955
WGP2	57	0.928
WGP3	51	0.920

B. Compressive Strength

Compressive strength of each concrete cube casted for 7days and 28 days curing are given in the table5. Tests were conducted as per IS: 516-1999. Compressive strength for reference concrete is 18.50 and 30.33 N/mm^2. On referring table 5 it is found that concrete mix WGP3 has highest compressive strength for 7 and 28 days cured concrete mix.

Table 5. Compressive Strength N/mm²

Mix	Strength after 7 days curing N/mm²	Strength after 28 days curing N/mm²
O	18.50	30.33
WGP1	23	35.60
WGP2	32.44	37.50
WGP3	35.40	41.66

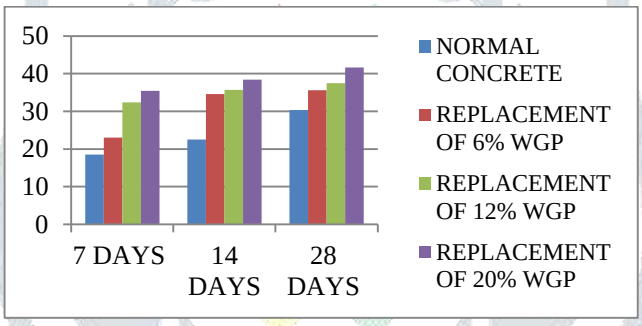

Figure 2.Graphical representation of Compression test Results Waste Granite Powder Comparative Conventional concrete.

VI. CONCLUSION

From the experimental test results, Granite dust powder found to be better performance in workability and strength properties.

1. The analysis of experimental data showed the reaction of with granite powder in concrete improved thestrength.
2. The disposal of granite powder should be maintained properly due to its unpozzolonicproperty.
3. In this the effective use of granite powder can be reduced the hazardness to the environment. At the same, theeconomical utilization of granite powder should be followed.
4. From the compression test results it is found that the concrete mix with 20% replacement of cement with Granite Dust Powder shows the higher compressive strength than the Reference concrete mix for both 7 days and 28 days curing.
5. From the experimental analysis, it is concluded that WPG3 mix, which is 20% replacement of Granite Dust Powder, is found to be the most preferable one when compared with other mixes by analyzing

its Compressive strength, Workability and Cost. It is recommended as favourable mix for both Structural and Non- Structural applications.

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