

Strenght and Durability Properties of Granite Powder Mixed Concrete



Engineering

KEYWORDS : Granite Powder, Strength, Durability Properties, Fine Aggregate, Concrete.

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ABSTRACT

An enormous amount of stone dust is produced as a sluggish waste material from the granite stone industry and various operations of stones. It has become a serious problem to the society and environment. Presently, use of river sand conforming to IS 383-1970 has become difficult because of unavailability and costly due to complicated rules and regulations. To overcome this difficulty, an economical alternative can be developed by partial replacement of sand with granite powder (GRP) in concrete. In this paper, a study is conducted to investigate the viable use of granite residue (GRP) in concrete mixes. Sand is replaced with GRP at 0%, 10%, 20% & 30% by weight for M20 grade of concrete. To study strength and durability properties of concrete, test on fresh and hardened concrete are conducted for all the mixes. The results show that GRP assimilation results enhancements in the compressive strengths of concrete by replacement up to 20% of GRP without affecting significant characteristics of the mix. The analysis confirmed that GRP are non-reactive materials and can act as filler in concrete. They can be used as a sustainable replacement for cement and fine aggregate.

INTRODUCTION

Leaving the waste materials to the environment directly can cause environmental problem. Hence the reuse of waste material has been emphasized. Waste can be used to produce new products or can be used as admixtures so that natural resources are used more efficiently and the environment is protected from waste deposits. It is estimated that cement production is responsible for about 3% of the global anthropogenic greenhouse gas emission and for 5% of the global anthropogenic CO₂ emission. As about 50% of the CO₂ released during cement production is related to the decomposition of limestone during burning, mixing of clinker with supplementary materials called blending is considered as a very effective way to reduce CO₂ emission.

The advancement of concrete technology can reduce the consumption of natural resources and energy sources and lessen the burden of pollutants on environment. Presently large amounts of granite dust are generated in natural stone processing plants with an important impact on environment and humans. This project describes the feasibility of using the granite dust in concrete production as partial replacement of sand. In INDIA, the granite and granite stone processing is one of the most thriving industry the effects if varying granite dust contents on the physical and mechanical properties of fresh and hardened concrete have been investigated. However as the by-product i.e. the powder differs chemically depending on the parent granite rocks which depend on the locality, degree of metamorphism and other factors; and also as the physical characteristics of the by-product depends on the polishing work, it

is necessary to conduct similar research in our country to incorporate it in concrete and cement production for reduction of environmental pollution and sustainable use of natural resources. Granite is a mixture of angular particles; colour can range from white to red to black and colors in between, ranging in size from pebbles to boulders. It is odorless and not flammable. Respirable dust particles containing silicon dioxide may be generated

by handling granite.

In this paper, too, efficacy of waste granite powders in concrete has been investigated by experimental tests on concrete without WM Powder/Granuals and with varying quantity of GRP and carried out laboratory investigation of mechanical properties of the concrete specimens containing diatomite and waste granite powder (GRP) by partially replacing 10% sand content by weight with GRP in one case and by replacing 20% sand by weight as well as 30% by weight with GRP in the other and found better compressive and flexural strength and came to the conclusion that the mechanical properties of concrete could be improved by reducing sand content. The strength properties of concrete were investigated by replacing natural sand by GRP at replacement levels of 10, 20& 30 percent. In this experimental study, the main objective is to study the influence of partial replacement of SAND with granite powder, and to compare it with the compressive strength of ordinary M20 grade concrete. Further, trying to find the percentage of granite powder replaced in concrete that makes the strength of the concrete maximum.

2. LITERATURE REVIEW

A study has been conducted on the use of waste material (granite powder). It has been found that 30 % granite dust can be used as an additive material in production of cement and its use does not affect the setting time of cement. In this process, granite dust with ordinary Portland cement was inter grinned at various ratios as 0%,10%, 20%, and 30% by weight. It showed that workability maximum strength can be observed same maximum strength can be observed when sand is replaced by 30% granite powder for curing of 3 days,7 days,14 days and 28 days. Even more affirmative effect of granite powder is marked at early ages, as it acts as effect on Strength and Durability Properties of Concrete Incorporating Granite Residues as Fillers

A study has been conducted and it was reported that the compressive strength with granite dust increased significantly up to

about 30 percent for concrete. It was also found that the flexural behaviour of reinforced concrete beams with granite dust was similar to that for conventional concrete. Reinforced concrete with granite stone dust is cheaper by about 8 percent compared to conventional reinforced concrete. A similar study has been conducted, it has been found that the concrete with granite sand used as fine aggregate have better mechanical strength compared to concrete with natural sand. It is concluded on the basis of literature that the Granite crushed sand is most suitable for use of crushed sand to be use in concrete.

TABLE FOR PHYSICAL PROPERTIES OF GRANITE POWDER.

s.l.no	Specification	Values
01.	Specific Gravity g/cc	2.77 - 2.82
02.	Chemistry	Felsic
03.	Density (lbs/ft3)	166.5
04.	Melting Point (°F)	Approx. 3,000
05.	Boiling Point (°F)	Approx. 4,000
06.	Thermal Conductivity (K)	~ 2.2
07.	Particle Shape	Irregular
08.	Mohr's Hardness	7.0
09.	Odor and Appearance	Black and white No odor
10.	Vapor Pressure	None
11.	Color	Pink, light gray, dark gray

3. MATERIALS USED

3.1 Cement-ULTRATECH brand, OPC 53 grade cement was used. All the cement used is from a single batch of week 10.

3.2 Fine Aggregate: The fine aggregate used are of river sand river bed and There results of test conducted are good.

3.3 Coarse Aggregate (C.A): The coarse aggregate used are 20 mm and 12.5 mm mixed. The test conducted on graded aggregate are satisfactory for the work.

3.4 Water: Potable water confirming to IS 456:2000 is used in the study. The source is normal tap water and free from any reactive ingredient.

3.5 Granite powder-Granite dust powder obtained from the Granite factory.

MIX PROPORTION.

water	cement	fine aggregate	course aggregate
0.50	1	1.76	2.97

Mix proportioning of grante powder.

MIX	MIX DETAILS
R	1:1.76:2.97:0.50
GR1	R-90%SAND AND 10% GRANITE POWDER
GR2	R-80% SAND AND 20% GRANITE POWDER
GR3	R-70% SAND AND 30% GRANITE POWDER

Quantity of cement, fine aggregate, course aggregate, granite powder.

mix	cement %	CA	FA %	grp %	w/c
R	100	100	100	0	0.5
GR1	100	100	90	10	0.5
GR2	100	100	80	20	0.5
GR3	100	100	70	30	0.5

4. TESTS CONDUCTED

Workability test and strength test were conducted for fresh concrete and compressive strength test was conducted for 3 dyas, 7 days, 14 days and 28 days curing.

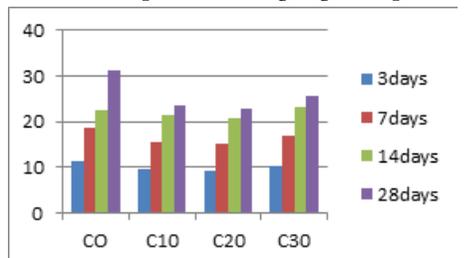
5. TEST RESULT AND DISCUSSION

A). Compressive Strength

Compressive strength of each concrete cube casted for 3 days, 7days, 14 days and 28 days curing are given in the table. Tests were conducted as per IS: 516-1999. Compressive strength for reference concrete is 10.38, 16.88, 23.37 and 25.70 N/mm2. On

referring table , it is found that concrete mix GR3 has highest compressive strength for 3, 7, 14 and 28 days cured concrete mix.

Table for compressive strength granite powder



Sample Series	3 days	7 days	14 days	28 days
C0	11.44	18.60	22.45	31.27
C10	9.66	15.46	21.40	23.54
C20	9.29	15.11	20.92	23.01
C30	10.38	16.88	23.37	25.70

The graphs for 3 days, 7 days, 14 days compressive strength and 28 days compressive strength.

6. Conclusions and Recommendations.

Compressive load on cube sample were applied under the compression testing machine. The average of three test are taken. Result indicates that compressive strength increase gradually with addition of GPR from 10% replacement of SAND with GRP, 20 % replacement of fine aggregate with GRP and 30% of GRP with sand. Beyond this range of the proportion of GRP, compressive strength decreases. The reason in that the GRP do not combine with gel during hydration process leading to weak micro structure of concrete. The compressive strength of concrete cubes, for all mix after curing 3 days, 7 days, 14 days and 28 days are presented in Table. When beyond 30 % sand is replaced with granite powder the compressive strength obtained is almost equivalent to that of basic mix, so the 30% use of granite powder in concrete gives us the more strength, hence 30% of GRP can be replaced with sand in concrete.

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