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# STUDY ON COMPRESSIVE STRENGTH CONCRETE AFTER REPLACING SAND WITH GRANITE POWDER

**1SANAPALA SAI KRISHNA DINAKAR, 2DR VARUDU SOWJANYAVANI**

**1PG STUDENT, 2ASSOCIATE PROFESSOR**

**1ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT,TEKKALI,**

**2ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT,TEKKALI**

ABSTRACT

This paper incorporates the results of strength values of M30 concrete by changing the percentage of granite powder (GP) taken in place of sand. The percentage replacements of sand with granite powder are 0%,10%, 20%, 30%, 40% and 50%. The parameter under study is compressive strength of concrete. Cement used is fly ash based Portland Pozzolana Cement. Experimental results indicated that the optimum percentage of replaced granite powder in sand is 30%.

KEY WORDS:- Granite powder, Portland pozzolana cement, Compressive strength.

## INTRODUCTION

Concrete consists of cement, coarse aggregate, fine aggregate, water along with additives if any. As day by day the availability of fine aggregate is decreasing. There might be an, alternate material which can be used in place of fine aggregate. The replaced material can be easily available and it should be comparatively economical. One of the replaced material can be granite powder. It comes from the crushing of granite stone which can be abundantly available at granite crushing plants. Granite powder being waste material, its utility helps the environment to reduce dumping of waste materials.

Now a days replacing the materials in concrete is a normal thing. In some point it is necessary to think about alternatives for materials used in making concrete. The alternatives for both coarse and fine aggregate is becoming mandatory for construction field for the purpose of environmental, technological and economical benefits.

This study mainly concentrates on the strength parameter while replacing the fine aggregate with granite powder with different proportions. At the same time while seeing the replacing materials for other concrete ingredients. In the coming modern world every civil engineer role to improve the construction practices in economical way and at the same time in a durable way of construction. One point should be remembered while searching for replacing or adding material to the concrete that when replacing or adding the strength parameters or other parameters should be improved. If thinking in a economical way also the parameters should improve or remain unchanged at any circumstances. It should not degrade the strength properties.

## OBJECTIVES OF THE STUDY

Many types of waste materials are available in surroundings which can be replaced in concrete. One such waste material is granite powder. The major goal of this experiment is to determine the optimum percentage of replacing sand with granite powder in percentages of 0 percent, 10%, 20%, 30%, 40%, and 50% in concrete. This research also aims to find strength of concrete after replacing granite powder in fine aggregate.

## LITERATURE REVIEW

Priyanka A.Jadhas & Dilip K. Kulkarni [1] mainly elaborate the effect of water cement ratio on hardened properties of cement mortar with a partial replacement natural sand by manufactured sand. The experimental study is carried at water cement ratio 0.5 and 0.55 for mortars 1:2, 1:3 and 1:6. Compressive test is carried on mortar cubes. Study concluded that the maximum compressive test comes at 50% of replacement of natural sand by manufactured sand. It also helps to find a viable solution to use the waste in a eco friendly way to the environment.

Dilip K. Kulkarni and Priyanka A. Jadhas. [2]focused on the effect of water cement ratio on hardened properties of cement mortar with a partial substitution of natural sand by artificial sand. It presents an experimental research on the effects of changing water cement ratios between 0.5 and 0.55. Compressive tests on mortar cubes are performed in this work. The maximum compressive test is performed when synthetic sand replaces natural sand by 50%. It also aids in the discovery of a suitable strategy for utilising garbage in an environmentally beneficial manner.

Sukesh Chandana et al. [3] because of the scarcity of natural sand and the need to reduce the cost of concrete production, there is a greater need to develop substitute materials for sand as fine aggregates in concrete production, particularly in concrete. One of these materials is quarry dust, which is a by-product of the crushing process used in quarrying. Granite fines, also known as quarry dust, are a by-product obtained after the crushing of granite rocks. In recent days, several attempts have been made to employ Fly Ash, an industrial byproduct, as a partial replacement for cement in order to improve workability, long-term strength, and reduce the cost of construction. The purpose of this study is to see if Quarry Dust can be used as a partial replacement for sand in concrete. The qualities of concrete have been studied, and some properties of quarry dust have been investigated to see if they are suitable for use as partial replacement materials for sand in concrete.

## COMPOSITIONS OF MATERIALS USED IN CONCRETE

### POZZOLANA PORTLAND CEMENT (PPC)

Pozzolana cement is a special type of cement which is used in heavy constructions to reduce the heat of hydration and which also reduces the reaction time between the cement particles. For the present study PPC conforming to IS 1489-1987 [4]is used.

### FINE AGGREGATE (SAND)

As from the early days itself the material used as fine aggregate is sand. As the usage of sand is increasing day by day the availability of the sand is reducing at the same time this fine aggregate is used as a filling material in the concrete. This minimizes the voids in the concrete therefore it leads to the increase in the strength of the concrete. The specific gravity and fineness modulus of fine aggregate is 2.7 and 2.24 respectively.

### REPLACED FINE AGGREGATE (GRANITE POWDER)

Crushed granite powder is used as a replaced material for fine aggregate in place of river sand. As the powder coming from granite it has the capable to increase load taking capacity of the concrete. At the same time it is a waste material it is also economical to use in the construction practices and it also acts as good filler material due to its fineness. Here the chemical composition is as in Table 1. The specific gravity of granite powder is 2.58 while fineness is 2.53.

**TABLE 1 CHEMICAL COMPOSITION OF GRANITE POWDER [5]**

| CHEMICAL COMPOUND | WEIGHT (%) |
|---|---|
| $SiO_2$ | 64.5 |
| $Al_2O_3$ | 12.01 |
| $Na_2O_3$ | 5.92 |
| $Fe_2O_3$ | 5.77 |
| $K_2O$ | 5.26 |
| CaO | 4.80 |
| $TiO_2$ | 0.67 |
| MgO | 0.57 |
| MnO | 0.39 |
| $P_2O_3$ | 0.07 |

COARSE AGGREGATE

Coarse aggregate opted for the present study is dark blue granite, conforming to IS 383-1970 [6 ] requirements. The specific gravity and fineness modulus is 2.85 and 6.26 respectively.

WATER

Portable water conforming to IS 3025-1986 [7 ] is taken for the present study.

MIX PROPORTIONS

The proportions of the concrete mix for M30 grade is 1:1.92:3.4, with a water cement ratio of 0.45 obtained with the help of IS 10262-2019 [ 8].

EXPERIMENTAL PROGRAM

The major goal of this experiment is to determine the effect of replacing sand with granite powder waste in percentages of 0 percent, 10%, 20%, 30%, 40%, and 50% on the hardened qualities of cement concrete. The casting, curing, and testing of specimens are all part of the experimental effort. Six experiments are carried out for each percentage, with Mix 1 being the reference mix with 0% granite powder (GP), Mix 2 being with 10% granite powder replacement, Mix 3 being 20% GP, Mix 4 being 30% GP, Mix 5 being 40% GP, and Mix 6 being 50% GP.

The trials are all carried out at room temperature. The dry materials for concrete, namely cement, fine aggregate, and coarse aggregate, are combined first. Granite stone powder is used as a partial replacement for natural sand, followed by the addition of a calculated amount of water and thorough mixing to achieve a uniform mix. Concrete cubes are compacted on table vibrator as shown in Fig.1.Layers of concrete are utilized for compressive strength testing and are cured in water as in Fig.2 for 28 days before being tested on a compressive testing machine (CTM) as in Fig.3.

**Fig.1 Compacting concrete in cube mould**

**Fig.2 curing of cubes in water tank**

**Fig.3 Specimen in compressive testing machine**

RESULTS AND DISCUSSIONS

The compressive strengths of concrete of grade M30 with substitution of fine aggregate with granite stone powder in the proportions 0 percent, 10%, 20%, 30%, 40%, and 50% is shown in Table 1 and fig 4. The compressive strength values at 28 days are shown in the table 2. The improvement in the strength may because granite powder being fine material filled pores in concrete making concrete dense. The dense concrete improved strength.

**Table 2 compressive strength values at 28 days**

| % REPLACEMENT OF GRANITE POWDER | COMPRESSIVE STRENGTH AT 28 DAYS (MPA) |
|---|---|
| 0% | 42.48 |
| 10% | 42.65 |
| 20% | 42.85 |
| 30% | 47.76 |
| 40% | 40.23 |
| 50% | 25.52 |

Conclusions

From the limited study it is concluded that fine aggregate can be replaced by granite powder. The optimum percentage replacement is 30.

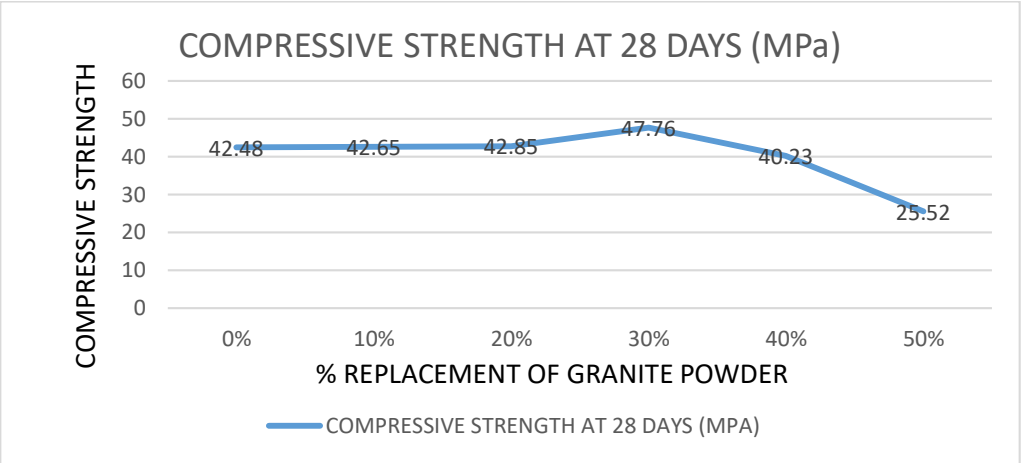


**Fig.4 Variation of compressive strength with replaced proportions of granite powder**

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