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Use of Stone Dust & Granite Powder as a Partial Replacement of Cement

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ABSTRACT
The research demonstrate the use of naturally available waste material as a partial replacement of OPC cement resulting in improving the compressive strength of cement. Since cement manufacturing process involves emission of CO_2 to a considerable amount in the environment resulting in global warming, thus use of these partial substituents in cement reduces this ill effect making an environment free construction.
The objective of this thesis is to find optimum percentage up to which these pozzolanic waste materials can replace OPC-43 grade cement to obtain maximum compressive strength. In this thesis OPC-43 grade cement is replaced partially by stone dust & granite powder simultaneously in the proportion of 5%, 10%, 15% & 20% by weight. Mortar cubes were casted, tested and compared in terms of compressive strength to the standard mortar mixtures. Cubes were subjected to compressive strength test to determine strength at 7 days, 28 days & 56 days. The result obtained clearly represents that on partial replacement of cement by 5% with stone dust, compressive strength obtained is maximum. On the other hand, higher strength is obtained when cement is replaced with 10% granite powder.
Keywords:Pozzolanic Waste Materials, Optimum Mix, Compressive Strength, Granite Powder, Stone Dust, OPC.

I. INTRODUCTION

Pozzolanic materials are those materials which do not possess any binding properties but when mixed with water along with lime (CaO) shows binding properties. These materials can be used as a partial substitute of cement thus enhancing strength and reducing the emission of CO_2 emission in the environment which causes global warming. In this research granite powder and stone dust is used as a partial replacement OPC-43 grade cement.

II. MATERIALS

1. Stone Dust:

The stone used in construction of High Court building, LUCKNOW UTTAR PRADESH is used as a major source. The stone dust generated during the process of cutting and polishing is used as the partial replacement of cement (OPC-43).

2. Granite Powder:

Granite is an igneous rock which is commonly used as a building material in the field of construction in various forms. Granite powder produced by the process of cutting and polishing of granite is exposed in environment producing health hazards, is used in our study.

3. Moorum/Sand:

The use of moorum is recognised as fine aggregates in preparing cement mortar mixture to Occupy maximum volume of the mortar mix. Fine aggregates are mixed in the ratio of 1:3 where 1 part is of cement and 3 parts are of fine aggregates.

4. Cement (Opc-43):

This type of cement is used in general construction where there is no requirement of special characteristics. It is manufactured by inter grinding portland cement clinkers (more than 40%) with a limited quantity of calcium sulphate (setting time) and about 4% to 5% other constituent as per standards of European Standard EN197-1. In this study ordinary portland cement of 43 grade similar to IS 8112: 2013 is being used.

III. METHODOLOGY

1. Preparation of Mortar Mixture:

Firstly, consistency of cement when partially substituted by stone dust & granite powder at different proportions is determined simultaneously by the use of vicat apparatus and is represented by 'P'. Now, mortar mixture is prepared by mixing cement with partial replacement of pozzolanic materials and fine aggregates in the ratio of 1:3 along with the water content required given by the formula:

$$water\ content = (\frac{P}{4} + 3)$$

The consistency of cement when partially replaced by pozzolanic materials at different proportions and their adjacent water content is show below:

Table 1: Consistency & water content for Granite Powder.

% replacement with GP	Consistency (%)	Water Content (%)
5%	24	9.00
10%	24	9.00
15%	25	9.25
20%	26	9.50

Table 2: Consistency & water content for Stone Dust.

% replacement with Stone Dust	Consistency (%)	Water Content (%)
5%	22	8.50
10%	22	8.50
15%	24	9.00
20%	25	9.25

2. Casting of cubes and their curing:

A sum of 48 cubes were casted in a mould of size 70.6 mm×70.6 mm×70.6 mm, with the face area of 50 cm^2. These cube were firstly dried in atmosphere and the demoulded and submerged in clean fresh water for curing till testing days i.e. 7 days, 28 days & 56 days.

3. Testing of Mortar Cubes:

Samples were taken out of curing tank and air dried for 3 to 4 hours and compressive strength test is performed on these cubes in accordance with BS 1881-116:1983 to find maximum compressive strength of mortar cubes. A load of 5000 KN at 5.00 mm/min rate of loading is applied by the compression testing machine on the mortar cubes. Compressive strength of the cubes is determined as:

$$compressive\ strength = \frac{Load}{Area}$$

Where, Area= 50 cm^2.

IV. RESULTS

Compressive Strength Test

The compressive strength test was performed on the samples after 7 days, 28 days & 56 days of curing and results are represented graphically as shown in figures below. The strength of samples is determined by taking the average of two samples at that proportion of replacement. As the result of compressive strength test, it was observed that on partial substitution of OPC by 5% of stone dust maximum compressive strength of 50.15 N/mm^2(MPa) is achieved at 28 days.

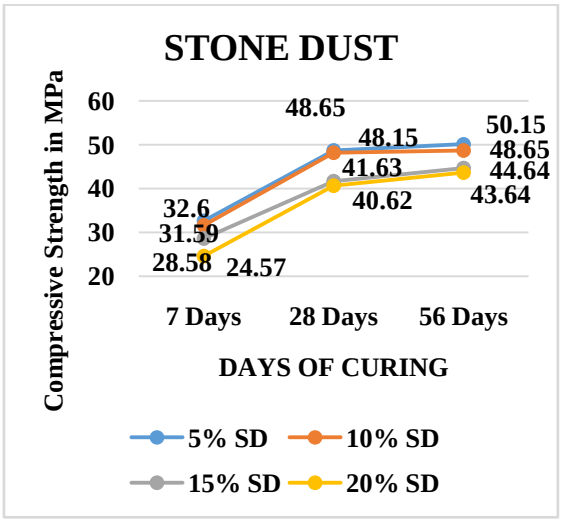

Figure 1: Graphical representation of compressive strength for Stone Dust.

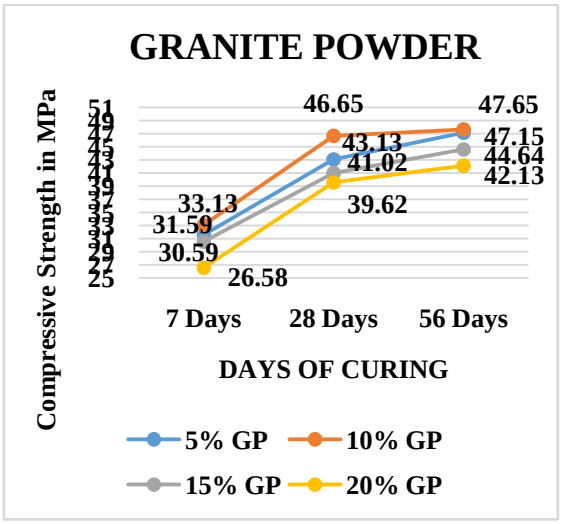

Figure 2: Graphical representation of compressive strength for Granite Powder.

V. CONCLUSON

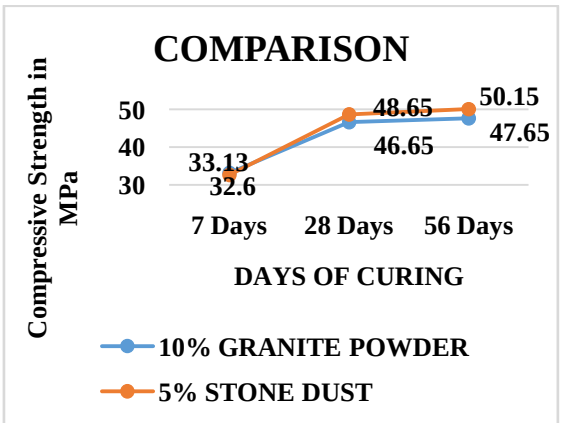

Figure 3: Comparative analysis to determine optimum mix proportion.

1. For stone dust the optimum level of replacement is up to 5% by weight.
2. For granite powder the optimum level of replacement is up to 10% by weight.
3. On addition of different pozzolanic waste materials (granite powder and stone dust) as a partial substitute of OPC cement the water content required to accomplish the reaction mechanism of cement increases.
4. It is observed that when cement (OPC-43) is partially replaced by 5% of stone dust the water content required is minimum as when cement is replaced by granite powder.
5. Maximum compressive strength is obtained when OPC-43 grade cement is mixed with 5% of Stone Dust.
6. Test results shows that replacement of OPC cement with 10% of Fly Ash by weight gives high strength at early days i.e. 7 days of curing and also improves strength of OPC cement with other properties with a considerable replacement quantity.
7. To obtain maximum compressive strength, the order of pozzolanic waste material used as a partial substitute of OPC cement can be concluded as:

   5% Stone Dust > 10% Granite Powder

REFERRENCES

[1]. Abhinav Singh, Dilip Kumar "Effect of Partial Replacement of Cement by Fly Ash and Addition of Granite Powder on the Properties of Concrete".
[2]. AbrarAwol "Using Marble Waste Powder in Cement And Concrete Production" March 2011.
[3]. A.M. Mustafa Al Bakri , H. kamarudin, M. Binhussain, I. Khairul, A.R. Rafiza and Y. Zarina "Comparison of Geoplymer Fly ash and OPC to the strength of concrete".
[4]. AnkitNileshchandra Patel, Prof. JayeshkumarPitroda "An Exploration study on stone waste as foregoing Alternatives for Green Concrete".
[5]. BS 1881-116: 1993, in testing Concrete. Method for determination of compressive strength of concrete cubes.
[6]. Dr. T. Felix Kala "Effect of Granite Powder on Strength Properties of Concrete".
[7]. European Standard EN 197-1 Cement in Part 1: Composition, specification and conformity criteria for common cements. Australian Standards Institute. (2008)
[8]. IS 650:1991 Specification for standard sand for testing of cement.
[9]. IS 3466:1988 Specification for masonry cement.
[10]. IS 4305:1967 Glossary of terms relating to pozzolana.
[11]. IS 5513:1996 Specification for vicat apparatus.
[12]. IS 8112:1989 Specification for 43 grade ordinary Portland.
[13]. Soman. K, Dr. K. A. Abubaker, "Strength Properties of Concrete with Partial Replacement of Cement by Granite Quarry Dust".
[14]. Y. Yaswanth Kumar, C.M. VivekVardhan, A. Anitha "Use of Granite Waste as Partial Substitute to Cement in Concrete".