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An Experimental Study on Cement Concrete with Partial Replacement of Cement Using Marble Dust Powder

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Abstract:- The waste generated from the industries motive environmental issues. For this reason the reuse of these wastes are often emphasised.Thus Marble dust powder (MDP) is one of the fast growing waste material which can be used in the concrete production industry to minimize material use and produce financial advantage. In this study, the marble dust powder passing through 90 micron sieve, has been utilized for determining the hardened properties of concrete .The hardened properties of concrete has been determined with the effect of different rate replacement of cement by MDP.In this examination work, MDP has replaced the Ordinary Portland Cement (OPC) at an increasing rate from 0 % to 20% by weight in M_{30} grade concrete. The motivation behind this investigation is to examine the behavior of concrete with the substitution of cement by MDP in various extents in concrete.

Keywords:- *Cement, concrete, compressive strength, flexure strength, marble dust powder, split-tensile strength.*

I. INTRODUCTION

Marble is obtained as the result of transformation of natural limestone. It is durable in characteristics and is used for construction and decoration purposes. During the cutting process, an enormous amount of marble dust powder are produced which causes ecological issues when it is exposed to the surrounding. Also the porosity and penetrability of topsoil reduces by means of deposition of MDP on the soil and it reduces the fertility of the soil by means of increasing alkalinity. Moreover, there will be only minimum amount of materials available for the production of cement .In order to overcome this problem MDP can be used as partial alternative of cement for casting of concrete.

Also these marble dust powder are utilised in various commercial sectors which assist to shield the environment. In recent times, concrete has a tremendous advancement in concrete technology wherein it may lessen the intake of natural assets as well as the energy sources and which can further reduce the effect of pollution on the surroundings. This project deals with the casting of the concrete with varying proportion of MDP and then analyzing the test results.

II. OBJECTIVE

To determine the effect of concrete with partially replacing cement with marble dust powder and finding the properties of hardened concrete such as compressive strength,split tensile strength and flexural strength and compared it with the normal concrete.

III. LITERATURE REVIEW

Manju Pawar , Arvind Dewagan (2014) examined the marble dust powder (pozzolanic material) for cement in high strength concrete. The hardened properties of concrete increases with increase in MDP content up to 12.5 % replacement by weight of cement and above that an increase in MDP content decreases the strength properties of concrete. Thus the result of the study shows that the strength properties of concrete has been improved by incorporating MDP to a desirable content of 12.5% by weight ofcement.

V.M. Sounthararajan , A.Sivakumar (2013) examined the effect of lime content in MDP on concrete properties.Thus this paper reports that the mechanical property of concrete increased compared to controlled concrete upto 10% replacement of MDP in cement content.

Baboo Rai,Khan Naushad, Abhishek, Tabin Rushad, Duggal.S.K. in 2011examined the result of high strength concrete using marble dust powder in concrete.In this study, cement and fine aggregate are partially replaced and examined the workability and hardened properties of concrete.Thus these replacement reveals that increase in MDP content results in increased workability and compressive strengths of concrete.

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IV. EXPERIMENTAL DETAILS

In this experiment, concrete (Grade M_{30}) were casted with appropriate replacement of cement by MDP upto 20% and properties were determined.In this assessment, physical properties of materials utilized were deteremined.

A. Properties of the Materials:

The physical properties of the materials utilized in the casting of concrete and the chemical compositions of the marble powder and cement utilized are shown in table 1,2 respectively.

Properties	Cement (OPC)	Marble dust powder	Fine aggregate (M-sand)	Coarse aggregate (Size 10mm to 20mm)
Fineness	4%	15%	2.2%	-
Normal consistency	30%	30%	-	-
Specific gravity	3.15	2.63	2.85	-
Initial Setting time	85mins	135mins	-	-
Impact strength	-	-	-	19.69%
Crushing strength	-	-	-	18.3%

Table 1:- Physical properties of Cement, Fine aggregate, Coarse aggregate , Marble dust powder.

Oxide compounds	(%)	
	Marble dust powder	OPC 53 grade
Calcium oxide (CaO)	42.45	57.02
Aluminumdioxide(Al2O3)	0.52	2.59
Silica dioxide (SiO2)	26.35	21.77
Iron oxide (Fe2O3)	9.40	0.65
Magnesium oxide (MgO)	1.52	2.71

Table 2:- Chemical composition of MDP and OPC(53grade).

B. Concrete Mix Constituents:

The materials used for manufacturing of concrete are shown in figure 1. (a),(b),(c),(d). The materials are mixed in the pan mixture as shown in figure 2 for making concrete.

(a) Cement

(b)M-sand

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(c)Marble dust powder

(d)Coarse aggregate

Fig 1:- Materials used in the study

Fig 2:- Mixing process in standard pan type mixer.

V. EVALUATION OF STRENGTH PROPERTIES

The quality of concrete depends upon the strength property of hardened concrete.Because of this importance,several tests has been conducted and their test results are reported as follows.

A. Compressive Strength Test:

For this test 100mmX100mmX100mm sized concrete cubes are used .The test is conducted on compressive testing machine. Mechanical behavior of concrete was studied for M_{30} grade concrete. At various proportions of marble dust powder,concrete cubes were casted and used for testing.Atlast cubes were tested and the outcomes acquired are shown below(In table 3 & graph 1).

Fig 3:- Experimental setup for compressive strength

% Replacement of MDP to cement	Compressive strength in N/mm^2		
	7 days	14 days	28days
0	47.08	48.06	51.012
5	27.46	42.18	44.145
10	26.48	40.22	41.202
15	20.6	38.25	40.22
20	15.69	34.33	37.278

Table 3:- Analysis of test results

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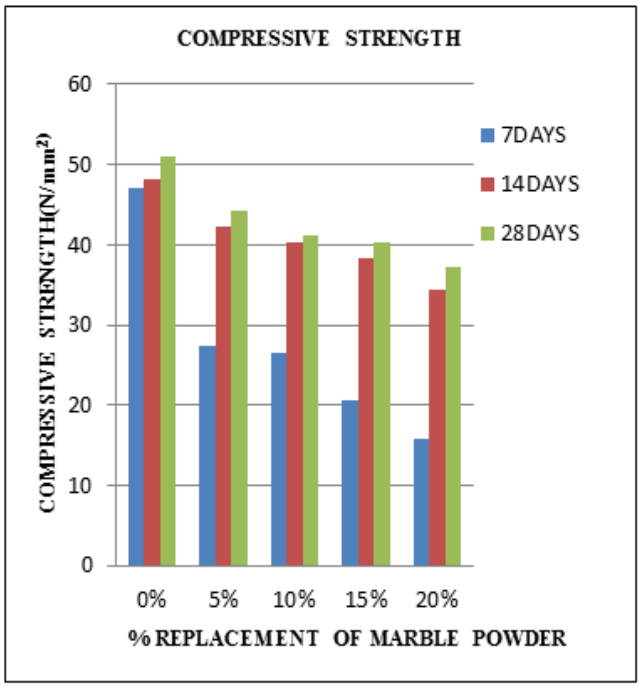

Graph 1

B. Split Tensile Strength Test:

For this test 100mmx200mm sized concrete cylinders are used. Load is applied over the surface of concrete cylinder till the failure takes place.Compression testing machine was used for this test.The cylinder is located horizontally and cylinder packing material is used to overcome sudden loading. The formula utilized for this test is,

$T = 2P/\pi DL$ (1)

Where,
T = Tensile Strength,
P = Load at which cylinder fails in N,
L = Length of cylinder,
D = Diameter of cylinder.

Thus the cylinders were tested and the outcomes acquired are shown below (In table 4 & graph 2).

Fig 4:- Experimental setup for split tensile strength

% Replacement of MDP to cement	Split tensile strength in N/mm²	
	14 days	28 days
0	4.05	4.99
5	3.74	4.37
10	3.12	4.05
15	2.81	3.74
20	2.49	3.12

Table 4:- Analysis of test results

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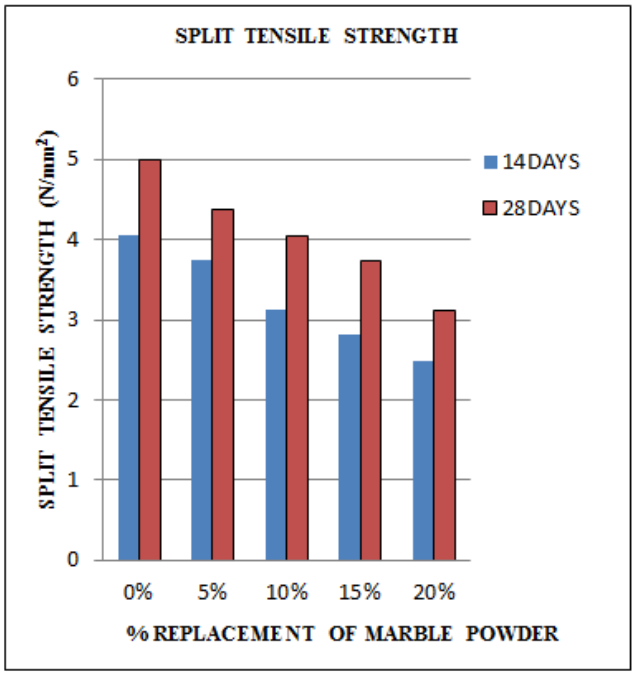


Graph 2

C. Flexural Strength:

For this test 500mmX100mmX100mm sized concrete prisms were used. Universal testing machine was used for finding the flexure .The surface of the prisms were cleaned before loading the machine. The prisms are placed in such a way that the axis of the prism lined up with the testing machine.Then the load is applied along the upper most surface.

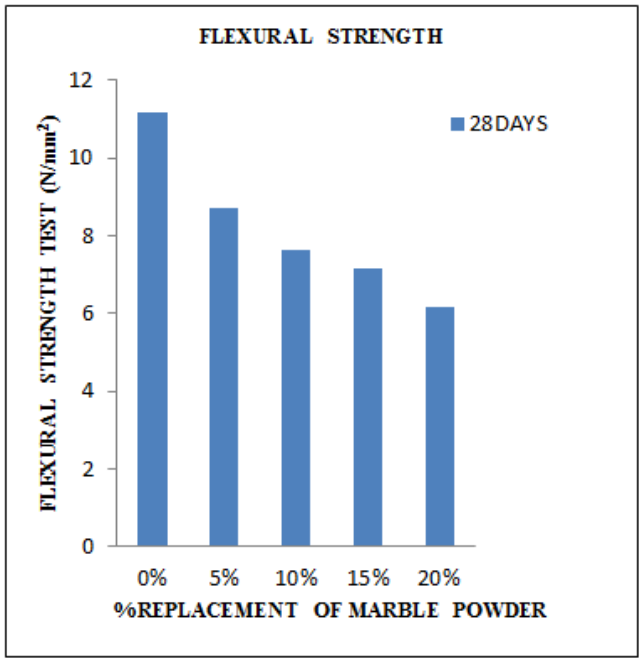
Flexural strength, (N/mm^2) = PL/bd^2 (2)
Where,
P =Load at which prism fails in N,
L = Length of prism,
b = Width of prism in mm,
d = Depth of prism in mm.

Then, the prisms were tested and the outcomes acquired are shown below (In table 5 & graph 3).

Fig 5:- Experimental setup for flexural strength test.

% Replacement of MDP to cement	28 days flexural strength in N/mm^2
0	11.18
5	8.73
10	7.65
15	7.16
20	6.18

Table 5:- Analysis of test results



Graph 3

VI. CONCLUSION

- Due to the excessive fineness of marble dust powder the pores in the concrete increases, which causes decline in compressive strength, split tensile strength and flexural strength of concrete with increase in marble dust powder content.
- Upto 20% replacement of cement by MDP the strength of concrete although gets decreased it does not reduce the strength below the design strength of concrete i.e.$M_{30.}$
- As the target strength of M_{30} grade concrete is about 38.25 MPa it is recommended to replace the cement by MDP for about 5%.
- Use of this MDP causes economical development in construction industry.

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