Partial Replacement of Cement with Dolomite Powder

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Abstract: Concrete is the most extremely used construction material within the world, which always uses natural resources like lime, aggregates and water. The production of cement in world has increased greatly, due to this cement production emission of CO2 gas has been increased tremendously, ultimately environmental pollution increased to very large extent. This affect to environment has been reduced by cement has been replaced by some supplementary materials like Dolomite Powder or Fly ash or GGBS & so on. Dolomite Powder was studied and lots of research work has been made on other waste materials and it is found there is a great future scope for research on Dolomite Powder as a replacement to cement, sand or both. In this study, the cement is partially replaced by dolomite powder at 10%, 20% and 30%. The preliminary properties of cement, fine aggregate and coarse aggregate are studied. The concrete specimens were prepared and tested for 7, 14 & 28 days strength. The Mechanical properties like compressive, flexural and split tensile strength of concrete with dolomite powder was compared with those of the reference specimens. As per the results this indicates the replacement of cement with dolomite powder increases the compressive and split tensile strength of concrete Within Certain limit. As per the result obtained 10% replacement of cement with dolomite powder has been done and which gives better result than conventional concrete, when examined for the mechanical properties.

KEYWORDS: Dolomite Powder, Ordinary Portland cement (53 Grade), Sand and coarse aggregate, Compressive Strength, Flexural Strength, Split tensile Strength.

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I. INTRODUCTION

As Day by day the production of cement is getting high and the use of cement is become the need of present as binder material in concrete. Due to Globalization the consumption of concrete is increasing, Concrete is the second most thing that is widely used all over the world, after water. Concrete is known to be the most wide spread structural material due its property to moulded in any form. It is a mixture of cement, fine and coarse aggregates and water. These materials possess problems of disposal, health hazards and aesthetic problems. The global consumption of cement is getting higher due to its extensive use in concrete.

As dolomite is material which is obtained from sedimentary rock bed also known to be "Dolostone". Dolomite can be used as replacement of limestone in cement. Dolomite has a good weathering resistance. It is well known the main component of dolomite is magnesium carbonate (MgCO3) and calcium carbonate (CaCO3), the decomposed temperature of CaCO3 is higher about 200 °C than the decomposed temperature of MgCO3. There are various reports from various universities and scientists states that due to large amount of concrete structures there is much adverse effect on the environment.

1.1 OBJECTIVES

1. To reduce the global consumption of cement in construction.
2. To increase the Mechanical properties like compressive, Flexural, Split tensile strength of the concrete.
3. To increase the workability of concrete.

LITERATURE REVIEWS

L.Ranjith Kumar, et al (2017) evaluated that Replacement of cement with dolomite powder is found to improve the strength of concrete. The maximum replacement percentage of cement with dolomite powder is found to be 5% and at this replacement level, the maximum increase in the 28th day compression and flexural strength were found to be 5.84% and 2.73% respectively. In case of split tensile strength, the optimal replacement is 5% and at this replacement level, the percentage increase in split tensile strength was found to be 2.74%.

Athulya Sugathan (2017) Evaluated that the Compressive strength of Cubes are increased with addition of dolomite powder up to 15% replaced by weight of cement and further any addition of dolomite powder the compressive strength decreases. now the Split Tensile strength of cylinders are increased with addition of dolomite powder up to 15% replaced by weight of cement and further any addition of dolomite powder the Split Tensile strength decreases. We have put forth a simple step to minimize the costs for construction with usage of dolomite powder which is freely or cheaply available. We have also stepped into a realm the environmental pollution by cement production; being our main objective as Civil Engineers.

II. MATERIALS USED

In this chapter, the various materials used in this experiment are:

2.1 Materials:

2.1.1 Cement:

Cement used for this research work is ordinary Portland cement (OPC-53 GARDE) available in the near market. For this research work, this cement is stored in dry and dark place and also covered with a poly bag to ensure the safety of cement against any types of moisture contact.

2.1.2 Fine Aggregate:

The material which passed through I.S. Sieve No. 480 (4.75mm) is termed as fine aggregates. Function of fine aggregates is to make concrete dense, by filling voids of coarse aggregates and Natural sand is used for experimental work.

2.1.3 Coarse Aggregate:

Aggregates influence the strength of concrete to great extent. For experimental 20mm size aggregate is used.

2.1.4 Dolomite Powder:

Dolomite powder is obtained by processing the sedimentary rock which is mineral; dolomite can be used as a replacement material for cement in concrete up to certain percentage. Dolomite powder has some similar properties as like of cement. Use of dolomite powder in concrete can minimize the cost of concrete and may also increase the strength to some extent.

Fig 2.1 Dolomite Powder

2.2 TESTS ON RAW MATERIALS:

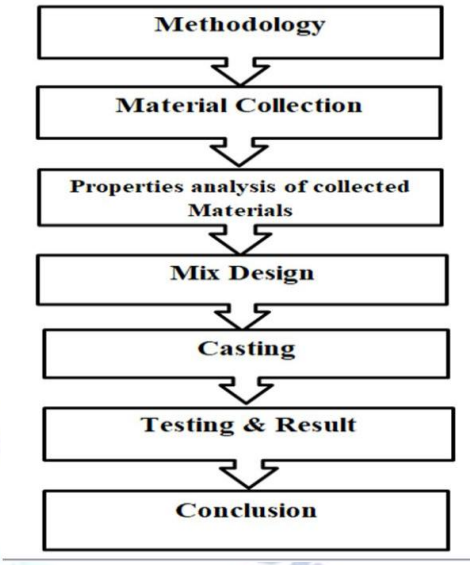
Table 2.1 Physical properties of Dolomite Powder

S.no	Composition	Value
1	Specific gravity	2.65
2	Colour	White Powder
3	Fineness modulus	2.47

Table 2.2 Result of tested raw material

1	Cement (OPC-53 Grade)	Fineness test	2.66
		Specific gravity	3.14
		Bulk Density	1450 Kg/m3
2	Fine Sand	Fineness test	2.70
		Specific gravity	2.68
3	Coarse aggregate	Specific gravity	2.97
		Impact value	18.59%
		Crushing value	18.57%
		Water Absorption	0.62%

III. METHODOLOGY



IV. MIX DESIGN

Mix design for M-30 concrete is done and amount of materials needed for casting cubes are calculated. Mix proportions for varying percentages of dolomite powder are fixed.

Table 4.1 Descriptive proportion of dolomite with cement:

MIX DESIGN	DESCRIPTION
M_0	Mix Design of M30 Grade concrete.
M_1	Concrete mix with 10% replacement of Cement with dolomite powder.
M_2	Concrete mix with 20% replacement of Cement with dolomite powder.
M_3	Concrete mix with 30% replacement of Cement with dolomite powder.

V. RESULTS AND DISCUSSION

According to IS: 1199 – 1959 workability test by slump cone on fresh concrete were tested at Concrete & test results are as follows.

Table 5.1 Slump values for various samples

S. No.	Samples	Dolomite Powder	Slump value (mm)
1	M0	0%	65
2	M1	10%	63
3	M2	20%	62

4	M3	30%	60

A. Compressive Strength Test:

The compressive strength measurement of the concrete samples was done as per IS 516: (1959) standard practiced. The test was conducted on the three samples of each composition and the average value will be compressive strength. The compressive strength values of different compositions of Dolomite powder and Cement are follows:

Table 5.2 Observation of Compressive Strength:

Days	Average Compressive strength		
Mix proportions	7Days (N/mm2)	14Days (N/mm2)	28Days (N/mm2)
DP-0-100C	25.4	35.2	39.25
DP-10-90C	27.1	37.2	41.46
DP-20-80C	24.5	33.7	37.65
DP-30-70C	22.34	31.1	34.45

From the experimental results it is clear that Compressive strength of the M30 Concrete mix when cement is substituted with dolomite powder 10%, then the strength is increased compared with conventional concrete. Dolomite is substituted with cement 20% and 30% respectively, the compressive strength is found to be reducing.

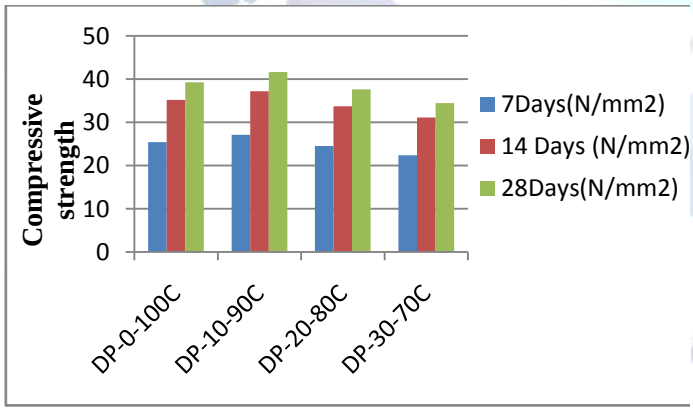


Chart 5.1 Comparison of Average Compressive strength

C. Flexural Strength Test:

For this research work, single samples were prepared for 7 days 14 days as well 28 days testing for each configuration with one additional sample of conventional concrete.

Table 5.3 Observation of Flexural Strength:

Days	Flexural strength		
Mix proportions	7Days (N/mm2)	14Days (N/mm2)	28Days (N/mm2)
DP-0-100C	3.20	4.34	4.8
DP-10-90C	3.35	4.44	5.01
DP-20-80C	3.10	4.17	4.71
DP-30-70C	3.02	4.05	4.46

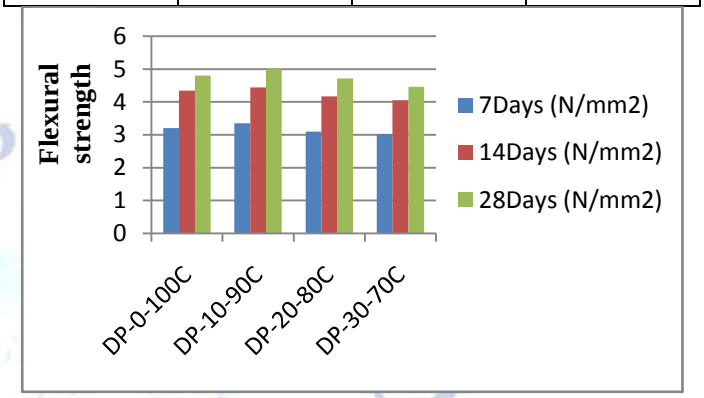


Chart 5.2 Comparison of Flexural strength

E. Split Tensile Strength Test:

Tensile strength of concrete greatly affects the extent and size of cracking in concrete. Tensile strength of concrete is less when compared with its compressive strength. Cylinders of diameter 150mm and height 300mm were used to determine the split tensile strength. After curing, the specimens were tested on the compression testing machine.

Table 5.4 Observation of Split Tensile Strength:

Days	Split Tensile Strength		
Mix proportions	7Days (N/mm2)	14Days (N/mm2)	28Days (N/mm2)
DP-0-100C	2.46	3.14	3.9
DP-10-90C	2.77	3.79	4.20
DP-20-80C	2.35	3.24	3.62
DP-30-70C	2.26	2.96	3.32

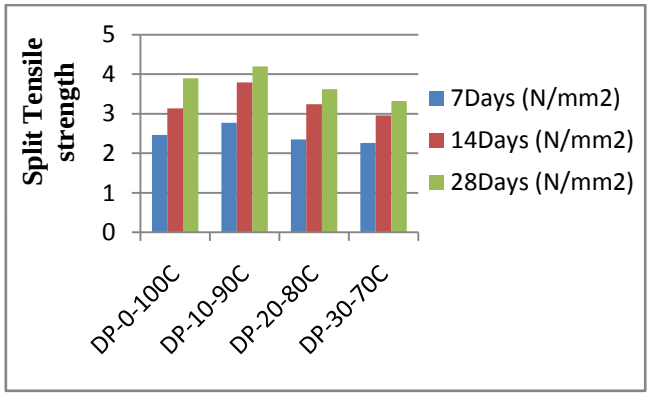


Chart 5.3 Comparison of Split tensile strength

VI. CONCLUSION

As per the experiment is conducted and various tests were performed, the following conclusions were made:

1. The compressive strength of concrete with 10% dolomite powder is 5.3% greater than compressive strength of conventional concrete.
2. The split tensile strength of concrete with 10% dolomite powder is 9.5% greater than split tensile strength of conventional concrete.
3. The flexural strength of concrete with 10% dolomite powder is 4.1% greater than flexural strength of conventional concrete.

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