

Experimental Investigation on Replacement of Cement in Concrete Partially by using Dolomite Powder

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How to cite this paper: Pramod Dhamne | Dr. P. B. Nagarnaik "Experimental Investigation on Replacement of Cement in Concrete Partially by using Dolomite Powder" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-3 | Issue-3, April 2019, pp.790-792, URL: <https://www.ijtsrd.com/papers/ijtsrd23035.pdf>



IJTSRD23035

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 This affect to environment has been reduced by cement has been replaced by some supplementary materials like Dolomite Powder or Fly ash or GGBS & so on.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 conducted detailed study 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. Now in our case, cement has been replaced partially with in varying proportions likewise from 0% to 20% and its effect has been analysed on the standard consistency, soundness, setting times of cement and compressive strength of cement mortar mixes. The cubes and cylinders of concrete were casted for variable content of dolomite powder.

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KEYWORDS: Dolomite Powder, Cement, Aggregates, Compressive strength test, Split Tensile Test

1. INTRODUCTION

Cement is one of the foremost ingredient of concrete, since it is having a property that it binds the aggregates and resists the atmospheric action. The producing process of cement is includes calcining argillaceous and calcareous materials at a high temperature. During conduction of this process, very large amount of CO₂ has been releasing into the atmosphere. It is estimated that in the production of one ton of cement results the emission of 0.8 ton CO₂. The various report use of replacement materials such as Dolomite powder, fly ash and limestone in Portland cement has much attention in recent years. The utilization of fly ash is one of the great & most popular methods to reduce expansion of concrete because of alkali-silica reactivity. Dolomite is a carbonate material which is made up of calcium magnesium carbonate CaMg (CO₃)₂. Dolomite is rock forming mineral created attention for its exceptional wettability and dispersibility. Dolomite has higher weathering resistance. Dolomite is a preferred as construction material due to it's higher surface area, hardness and density. Dolomite used as a filler material due to its higher strength and hardness. By the effective utilization of dolomite powder as a construction material, the objective in reduction of construction cost can be

achieved. An attempt was attained to explore the possibility of using dolomite as a replacement material for cement M30 grade concrete and its specimens were made by replacing 0, 5, 10 & 20% of cement by dolomite powder. The Compressive, Split tensile and Flexural strength of the specimens were found on the 7th and 28th days. Optimal replacement percentage of dolomite was determined.

2. Liturature Review

2.1. Author: Shanu Sharma

Author studied use of cement and production of cement produces much more issues of environment and also it is costlier process. Hence Marble Dust Powder can used as a developing binding material which will allow the concrete industry to optimize waste material use, reduce construction cost and construction of structures will be strong, durable and sensitive to the environment. The MDP was replaced with cement 0%, 7%, 14%, & 21% by weight for M25 grade concrete. Flexural & compressive strength Test are Conducted. The results achieved from this existing study shows that MDP has great potential for utilisation in concrete as an replacement of cement.

2.2. Authors: Preethi

Author done experimental study on possibility of use of dolomite powder as an partial replacement material to cement. The some partial replacement percentages in experimental study were 0%, 5%, 10%, 15%, & 20% by weight of cement. The compressive, split tensile & flexural strengths of M20 concrete was conducted with dolomite powder were compared with those of reference specimens. It is found use of replacement of cement with dolomite powder to improve the strength of concrete is successful.

3. Methodology & Mix Design

Material

Cement: Ambuja Fifty Three grade cement which is confirming to IS 12269: 2013 used throughout the work. The cement used were fresh, lump free & dry. All possible external content was uncontaminated while storing cement. Some properties of cement was found which are shown in following table I.

TABLE I

Physical properties of cement Properties	Results
Fineness	7%
Specific gravity	3.16
Initial setting	150 min.
Final setting	270 min.

Fine Aggregate:

The most important property of fine aggregate is to assist in producing workability and uniformity in the concrete mixture. The fine aggregate is also allows the cement paste to hold and binding coarse aggregate particle in suspension. This action promotes plasticity in the whole mixture and prevents the possible segregation of paste and coarse aggregate. It should be durable, clean and be free from organic matters. River sand were used as an fine aggregate. The specific gravity of sand is found to be 2.56.

Coarse Aggregate:

The coarse aggregate is largest ingredient of concrete. In the presence of coarse aggregate in concrete reduces the drying, shrinkage and other dimensional changes occurring on account of movement of moisture. In this hard broken stone used as coarse aggregate in concrete. Here Size of coarse aggregate used in the Experiment was 20mm. The specific gravity of the coarse aggregate found to be 2.68.

Table II

Properties	Coarse Aggregate	Fine Aggregate
Specific gravity	2.67	2.70
Bulk density	1558.5 kg/m ³	1632.9 kg/m ³

Dolomite: Dolomite is a carbonaceous or carbonate material which is composed of calcium magnesium. Carbonate $\text{CaMg}(\text{CO}_3)_2$. The term carbonate itself used to describe the sedimentary carbonate rock Dolostone (Dolomite Rock) it is composed predominantly of mineral dolomite with stoichiometric ratio of 50% or greater content of magnesium replacing calcium, often as a result of digenesis. Dolomite is a rock forming mineral which is noted for remarkable Wettability and dispersibility as well as moderate oil and plasticizers absorption.



Dolomite Powder

Table III

S. No	Property	Dolomite Powder
1.	Formula	$\text{CaMg}(\text{CO}_3)_2$.
2.	Sp. Gravity	2.85
3.	Color.	White, Off White
4.	Tenacity	Brittle
5.	Mosisture contant (%)	Nil
6.	Crystal system	Trigonal

Water:

Water is an important ingredient in concrete as it is actively participates in the chemical reaction along with cement. The water which is used for making concrete should be clean and free from impurities like organics, oil, alkalis, acids etc.

Water which was used for making concrete should have a pH between 6 to 8. Locally available drinking water used in this work.

Details of Concrete Mix:

Grade of concrete is Selected as M30 and the mix design were done as per IS: 10262 - 2009 & IS: 456-2000 for different percentage of dolomite powder replacing cement partially. Mixture is prepared at room temperature. Test specimens of prescribed mix designs are prepared and allowed to cure in water for 7 and 28 day at room temperature. Finally, tests are conducted for Compressive Strength, Split Tensile Strength on 7th and 28th day respectively.

Four concrete mixes was designated as Mix-1(Control Mix), Mix-2(5% Dolomite), Mix-3(10% Dolomite), Mix-4(20% Dolomite).

4. Details of Experimental Study

1. Compressive Strength Test:

For this experiment 150 mm × 150 mm × 150 mm cubes of concrete were casting using M30 grade of concrete. Specimens made with ordinary Portland cement (OPC) and it was replaced with dolomite powder at 5%, 10%, and 20%, levels were casting was done. After 24 hours specimens were removed from mould and they are placed for water curing for 7 and 28 days. After curing, the specimens tested for compressive strength using compression testing machine.

2. Split Tensile Strength Test:

The tensile strength of concrete is one of basic and important property of the concrete. The split tensile strength test was conducted on concrete cylinder is method for determining the tensile strength of concrete. The split Tensile strength is tested on cylinders at different

percentage of dolomite powder Content in concrete. The strength of concrete has been tested on cylinder at 7 days and 28 days curing 7 days test has been conducted to check the gain in initial strength of concrete 28 days test gives the data relating to final strength of concrete at 28 days curing. It is found and can be seen that dolomite powder improves the compressive and split tensile strengths of concrete. As the percentage of replacement of cement partially with dolomite powder increases the compressive & split tensile strengths increases.

5. Results

1. Compressive Strength of Concrete

Table IV

Mix	Compressive Strength (7DAYS)(N/mm ²)	Compressive Strength (28 DAYS) (N/mm ²)
Mix 1	17.11	28.48
Mix 2	23.53	42.51
Mix 3	27.10	46.37
Mix 4	26.33	38.27

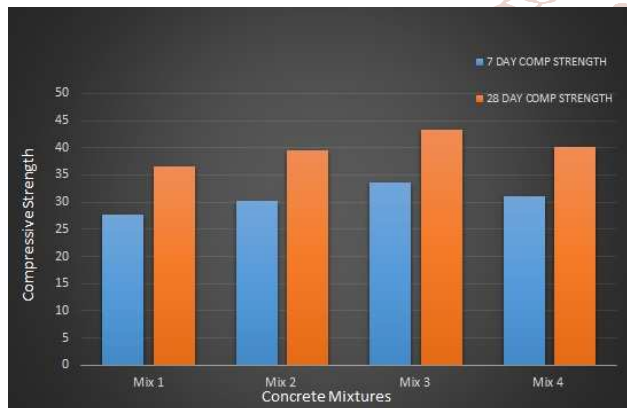


Chart1.Compressive Strength of Concrete at 7th & 28th Days

2. Split Tensile Strength of Concrete:

The split tensile strength of concrete was determined from Cylindrical Specimen of diameter 150 mm and height 300 mm.

Table V

Mix	7 Days (N/mm ²)	28 Days (N/mm ²)
Mix 1	2.38	3.20
Mix 2	2.46	3.28
Mix 3	2.63	3.51
Mix 4	2.42	3.40

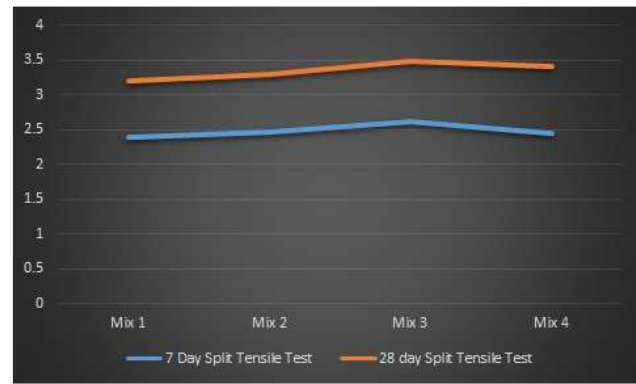


Chart2. Split tensile Test at 7th & 28th day

6. Conclusion

The Compressive strength of Cubes are increased with addition of dolomite powder up to 10% replaced by weight of cement & further any addition of dolomite powder the compressive strength decreases. The Split Tensile strength of Cylinders are increased in the addition of dolomite powder up to 10 % replaced partially by weight of cement and further any addition of dolomite powder resulted the Split Tensile strength decreases. We have been found out the optimum replacement percentage of dolomite powder with cement and it is 10% of cement for both cubes and cylinders. We have put forth a simple step to minimize the costs for construction with usage of dolomite powder which is much more cheaply available. We have also stepped in into a realm the environmental pollution by cement production & make use of cheaper material to get required quality of construction it has been our main objective as a Civil Engineers.

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