Investigation on Replacement of Cement in Concrete Partially by Using Dolamite Powder

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Abstract— **Concrete is the most highly used construction material in the world, which uses natural resources like lime, aggregates and water. The production of cement in world has greatly increased, due to this production emission of CO_2 gas has been increased ultimately environmental pollution increases. This effect to environment has been reduced by cement has been replaced by some supplementary materials like Dolamite Powder or Fly ash & so on. Dolamite Powder was done detailed study and lots of research work has been done on other waste materials and there is a great future scope for research on Dolamite Powder as a replacement to cement, sand or both. Now in our this case, cement has been partially replaced with in varying proportions 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 varying content of dolomite powder.**

Keywords*— *Dolamite Powder,Cement,Compressive test,Split Tensile Test.

I. INTRODUCTION

Cement is one of the most important ingredient of concrete, since it has property that it binds the aggregates and resists the atmospheric action. The manufacturing process of cement is calcining argillaceous and calcareous materials at a high temperature. During this process, very large amount of CO2 is releasing into the atmosphere. It is estimated that the production of one ton of cement results in the emission of 0.8 ton of CO2. The various report use of replacement materials such as Dolamite powder, fly ash and limestone in Portland cement has much attention in recent years. The utilization of fly ash is one of the most popular methods to reduce expansion of concrete due to alkali–silica reactivity. Dolomite is a carbonate material which is composed of calcium magnesium carbonate CaMg $(CO3)_2$. Dolomite is a rock forming mineral which made attention for its remarkable wettability and dispersibility. Dolomite has a better weathering resistance. Dolomite is a preferred as a construction material due to its higher surface hardness and density. Asphalt and concrete applications used dolomite as a filler material due to its higher strength and hardness. By the effective utilization of dolomite powder as a construction material, the objective of reduction of cost of construction can be acheived. An attempt has been made to explore the possibility of using dolomite as a replacement material for cement. M30 grade concrete specimens were made by replacing 0, 5, 10 & 20% of cement with 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.

II. LITURATURE REVIEW

Author: Shanu Sharma Studied use of cement and production of cement creates much more issues of environment and also costlier process. Hence Marble Dust Powder can used as a developing binding material which will allow the concrete industry to optimize material use, produce financial profit and construct of structures will be strong, durable and sensitive to the environment. The MDP was replaced with cement at 0%, 7%, 14%, & 21% by weight for M25 grade concrete. Flexural & compressive Test are Conducted. The results achieved from the existing study shows that MDP is great potential for the utilisation in concrete as replacement of cement.

Authors: Preethi Done experiment on possibility of using dolomite powder as a partial replacement material to cement. The some replacement percentages in experiment was 0%, 5%, 10%, 15%, & 20% by weight of cement. The compressive, split tensile and flexural strengths of M20 concrete was made with dolomite powder were compared with those of the reference specimens. Replacement of cement with dolomite powder is found to improve the strength of concrete.

III. METHODOLOGY & MIX DESIGN

A. Material

Cement: Ultratech 53 grade cement which is confirming to IS 12269:2013 was used throughout the work. The cement used was fresh, free from lump & dry. All possible external content was avoided while storing cement. Properties of cement was found are shown in table.

TABLE I

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

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

Coarse Aggregate: The coarse aggregate is largest component of concrete. Presence of coarse aggregate in concrete reduces the drying, shrinkage and other dimensional changes occurring on account of movement of moisture. Hard broken stone used as coarse aggregate in concrete. Size of coarse aggregate used in the Experiment was 20 mm. 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/m3	1632.9 kg/m3

Dolomite: Dolomite is a carbonate material which is composed of calcium magnesium Carbonate CaMg (CO3)2. The term carbonate is also used to describe the sedimentary carbonate rock dolostone. Dolostone (Dolomite Rock) 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.

Dolamite Powder

Table III

S. No	Property	Dolomite Powder
1.	Formula	$CaMg(CO3)_2$.
2.	Sp. gravity	2.85
3.	Color	White, Off White
4.	Tenacity	Brittle
5.	Mosisture contant (%)	Nil
6.	Crystal system	Trignal

Water: Water is an important content 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 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 taken as M30 and the mix design is 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 7^{th} and 28^{th} day respectively.

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

IV. Details of Experimental Study

1. Compressive Strength Test:

For this 150 mm × 150 mm × 150 mm cubes of concrete were casting using M30 grade of concrete. Specimens made with ordinary Portland cement (OPC) and OPC replaced with dolomite powder at 5%, 10%, and 20%, levels were cast. After 24 hours specimens were removed from mould and 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. Split tensile strength test on concrete cylinder is method for determining the tensile strength of concrete. Split Tensile strength is tested on cylinders at different percentage of dolamite 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 can be seen that dolamite powder improves the compressive and split tensile strengths of concrete. As the percentage of replacement of cement partially with dolamite powder increases the compressive & split tensile strengths increases.

V. RESULTS

A. Compressive Strength of Concrete

Table IV

Mix	Compressive Strength (7 DAYS) (N/mm^2)	Compressive Strength (28 DAYS) (N/mm^2)
Mix 1	35.11	41.48
Mix 2	35.55	42.51
Mix 3	36.10	46.37
Mix 4	33.33	38.27

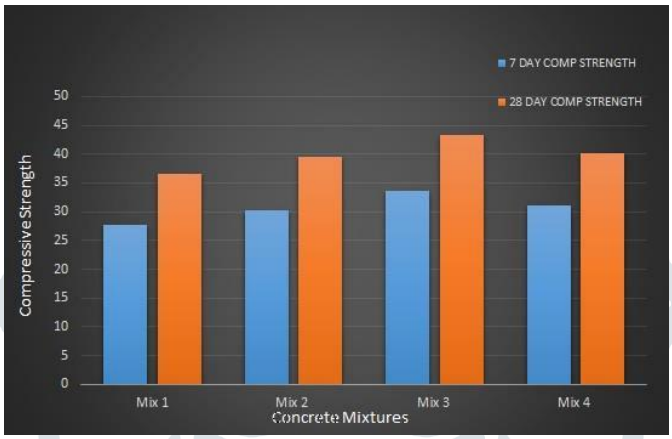

Fig. Compressive Strength Of Concrete at 7^{th} & 28^{th} Days

B 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/mm2)	28 Days (N/mm2)
Mix 1	2.39	3.21
Mix 2	2.47	3.29
Mix 3	2.62	3.49
Mix 4	2.44	3.41

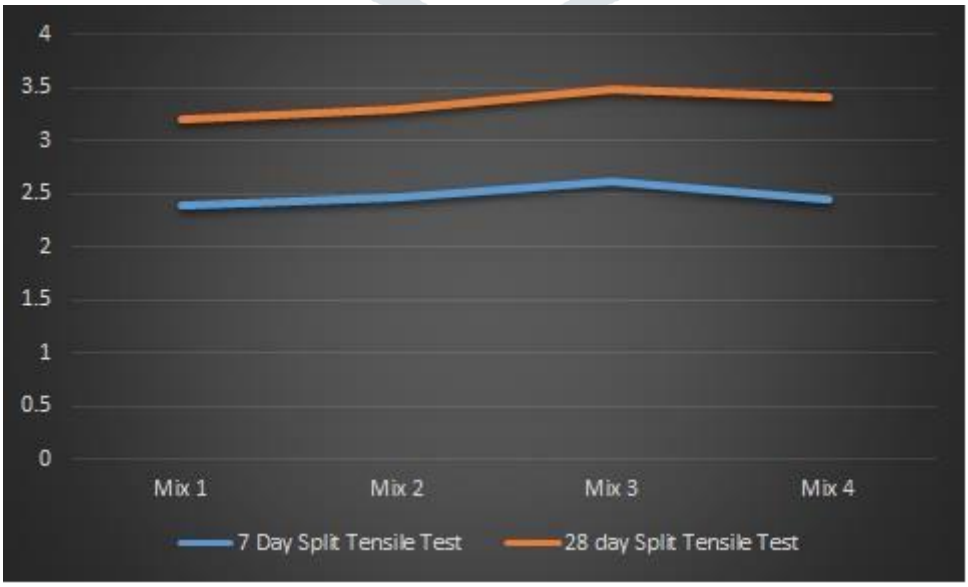

Fig. Split tensile Test at 7^{th} & 28^{th} day

VI. 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 with addition of dolomite powder up to 10 % replaced by weight of cement and further any addition of dolomite powder the Split Tensile strength decreases. We have 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 freely or cheaply available. We have also stepped into a realm the environmental pollution by cement production & make use of cheaper material to get required quality of construction it is being our main objective as a Civil Engineers.

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