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"Effect on Concrete Strength due to Partial Replacement of Cement in Concrete with Dolomite Powder"

K.C. Gund[1], V.G. Patwari[2]

[1]P.G. Student, Department of Civil Engineering, M.S. Bidve Engineering College, Latur,
[2]Professor, Department of Civil Engineering, M.S. Bidve Engineering College, Latur, Maharashtra, India.

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 This effect to environment has been reduced by cement has been replaced by some supplementary materials like Dolomite Powder or Fly ash & so on. Detailed study and lots of research work has been done on different waste materials for their use in construction industries and there is a great future scope for research on Dolomite Powder as a replacement to cement, sand or both. Dolomite powder has some similar characteristics of cement. Using dolomite powder in concrete can reduce the cost of concrete and may increase the strength to some extent. This paper examines the possibility of using dolomite powder as a partial replacement material to cement. The replacement percentages tried were 0%, 5%, 10% and 15% by weight of cement. The compressive and flexural strength of concrete with dolomite powder was compared with those of the reference specimens. The results indicate that replacement of cement with dolomite powder increases the compressive and split tensile strength and flexural strength of concrete.*

Key Words: **Dolomite Powder, Cement, Compressive Strength, Split Tensile Strength, Flexural strength, etc.**

1. INTRODUCTION

Concrete is the basic civil engineering material used in most of the civil engineering structures. The recent development in the field of concrete technology represents a great step toward manufacturing of concrete, Concrete is the second most widely used material globally, after water (Sidney 2011). It is the foundation of the built environment from our homes to the roads. Portland cement (PC) is considered to be the best building material for its high mechanical strength. However, ordinary PC does not only have insufficient durability performance but also low resistance towards chemical attacks, also the cement industry is one of the most energy-consuming and greenhouse gases emitting industry which is responsible for 7% of the global carbon dioxide emissions. The urge for materials with less embodied energy and carbon foot print stimulated research on developing new and sustainable alternatives or blended cements with lower embodied energy to cope with the rapidly growing cement and concrete demand which is expected to double by 2050, due to the rapid structural and infrastructural development in developing countries.

Blended cements, in which a percentage of PC is substituted with either slag and other mineral additives such as limestone and silica fume, are now commonly used, and which reduce the production of PC, as well as enhance the performance. Many materials are used to manufacture good quality concrete. Cement, fine aggregate, coarse aggregate, mineral admixtures, chemical admixtures and water are the constituents of concrete. Cement is the most important constituent material, since it binds the aggregates and resists the atmospheric action. As we came to know that manufacturing of cement emits about 0.8 ton of CO2 in atmosphere for every ton of cement manufacture. The utilization of supplementary cementing materials as natural Pozzolans like dolomite powder, rice husk ash, fly ash, egg shell powder, sugarcane bagasse ash, silica fume, Metakaolin etc. in concrete production is one of the solutions to reduce the cement content as well.

Approach towards the partial replacement of conventional clinker with such alternatives as fly ash, bottom ash, and slag, all of which are by-products of other industries that would otherwise end up in landfills. Fly ash and bottom ash come from thermoelectric power plants, while slag is a waste from blast furnaces in the ironworks industry. These materials are slowly gaining popularity as additives, especially since they can potentially increase strength, decrease density, and prolong durability of concrete.

Dolomite is a carbonate material composed of calcium magnesium carbonate CaMg $(CO3)_2$. Dolomite is a rock forming mineral which is noted for its good wettability and dispersibility. Dolomite Powder (DP) is the limestone powder with composition of CaCo3 and MgCo3 pertaining to 100% in combination, the proportion being varied as per mining zone. Dolomite has a good weathering resistance. Dolomite is a preferred for construction material due to its higher surface hardness and density. Asphalt and concrete applications prefer dolomite as a filler material due to its higher strength and hardness.

Dolomite has different grades and is available in different mesh sizes. By the proper usage of dolomite powder, the objective of cost reduction of construction can be obtained. We found the cost of dolomite is very cheap than cement, locally when we gone for purchasing it did not took difficulty its easily available locally and at very low cost.

During this research work we came to know about various great properties of dolomite powder that will not only prevent global warming but also will be economical for peoples who are not having ability to build their residence due to such higher rated materials. We bought this alternative material at just 2.5 Rs per kg means 2500 Rs. per ton, we were shocked that such low amount will definitely replace the cement content upto some extent, as cement is 6.5 Rs per kg which is much greater than dolomite price, we all well known about the great properties of cement but cement content can be replaced upto some extent, these sentence means that the area under any component in concrete structure where such cementious properties is not required there we can add such filler materials to gain economy on the graph of good strength and by this material workability of also gets improved.

Concrete becomes more durable and working conditions in the high tempered areas can also being reached without any costly plasticizers and admixtures. M30 grade concrete specimens were made by replacing 0, 5, 10, and 15% of cement with dolomite powder. The Compressive, Split tensile and Flexural strength of the specimens were found on the 7th & 28th days from which Optimal replacement percentage of dolomite was determined.

1.1 Materials

CEMENT: Ordinary Portland Cement (OPC) of 43 grade was used throughout the course of the investigation. The physical properties of the cement as determined from various tests conforming to Indian Standard IS: 1489:1991.

DOLOMITE POWDER was collected from the dolomite powder manufacturing factory. It was sieved by IS-90 micron sieve before mixing in concrete. Dolomite is a carbonate material composed of calcium magnesium carbonate CaMg (CO3)2. The term is also used to describe the sedimentary carbonate rock dolostone. Dolostone (dolomite rock) is composed predominantly of the mineral dolomite with a stoichiometric ratio of 50% or greater content of magnesium replacing calcium, often as a result of digenesis.

Advantages of Dolomite Powder

- Dolomite has good weathering resistance
- Higher degree of purity, wet ability and whiteness.
- Dolomite is popular for its shear and compressive strength.
- Fire resistive and solid.
- Long lasting life and stiffness.

COARSE AGGREGATES are those chemically inert materials which when bonded by cement paste form concrete. Aggregates influence the strength of concrete to great extent. The properties of concrete are directly related to those of its constituents and as such aggregate used in a concrete mix should be hard, strong, dense, durable, and free from lumps of clays, loam, vegetable and other such foreign matter. The presence of all such debris prevents adhesion of cement on the surface of aggregates and hence reduces the strength of concrete. The specific gravity of coarse aggregate is found to be 2.65.

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 2.44.

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 between6 to 8. Locally available drinking water used in this work.

1.2 Methodology

The designs of mix M30 using ordinary Portland cement were carried out for the study as per concrete mix proportioning guidelines specified by IS456-2000 and IS-10262-2009. Mixture is prepared at room temperature. Test specimens of prescribed mix designs are prepared and allowed to cure in water for 28 days at room temperature. Four concrete mixes was designated as Mix 1 (0%), Mix 2 (5% Dolomite), Mix 3 (10% Dolomite), and Mix 4 (15% Dolomite).

Concrete cubes of 150*150*150 mm^3 of standard size were prepared for compressive strength test and concrete beams 150*150*700 mm^3, is adopted for the study of flexural strength. Finally, tests are conducted for flexural strength on 28th day.

2. FLEXURAL STRENGTH TEST

The flexural strength test was determined according to B.S.1881: part118, 150 x 150 x 750 mm specimens were tested. The flexural strength of the specimens were calculated by the following equation:-

$$Fr = \frac{PL}{bd^2}$$

Where:-

Fr = modulus of rupture, (N/mm^2).

P = maximum applied load, (N).

L = span length, (mm).

b = width of the specimen, (mm).

d = depth of the specimen, (mm).

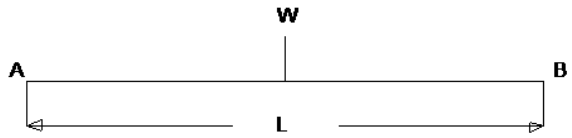

Fig -1: Single Point Load Method

The beam specimen will simply supported with a concentrated load applied at mid span, as shown in figure. Load will applied by using UTM (40 tons capacity) in 10kg increments up to failure load. At each load increment, cracks will inspected and marked, and the beam is photographed. Continuous monitoring will carried out all through the testing.

TEST RESULT

Table -1: Flexural Strength Test Result

Sr.no.	MIX	Flexural Strength in MPA for 28th day
1.	Mix1 (0%)	4.222
2.	Mix2 (5%)	4.696
3.	Mix3 (10%)	6.923
4.	Mix4 (15%)	5.533

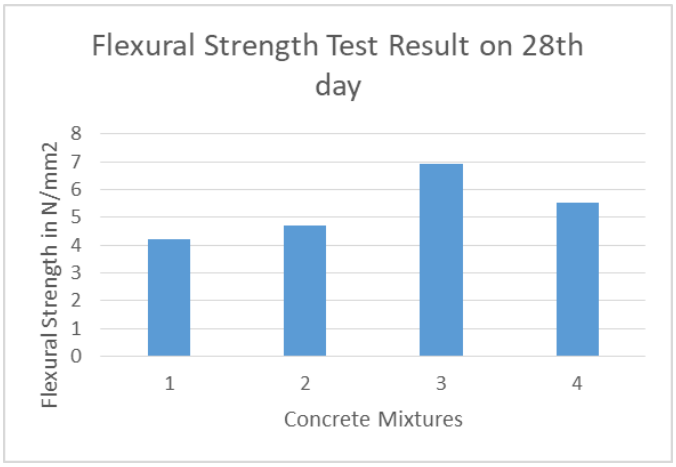

Chart -1: Result of Flexural Strength Test

3. CONCLUSION

The Flexural strength of Beams are increased with addition of dolomite powder up to 10% replaced by weight of cement and further any addition of dolomite powder decreases the strength. We found out the optimum percentage for replacement of dolomite powder with cement and it is 10% cement for both cubes and beams**.** 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.

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