"An Experimental Investigation on Aramid Fiber Concrete by Partial Replacement of Cement with Dolomite Powder"

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Abstract*— Concrete is a building material that is made of cement, fine and coarse aggregate and water Presently a days the value of those materials are accrued thus, we would like to appear at the simplest way to decrease value of building materials generally cement one in every of the modern development in housing industry is additional of materials in concrete. The partial replacement of materials reduces price, energy savings and protection of environment. To reach these we are partially swapping the cement with marble powder produced from marble industries. Progressive concrete technology becomes advanced to the concrete properties. This paper current and mechanical property of concretes made with and dolomite powder as cement replacement in different amounts. Research in this field and progressive results are essential so as to continue all developments with minimum damage to surrounding environment and tracking down all infrastructures for services and convenience which are preferred to get.

Keywords*—Concrete, Concrete Properties, Dolomite powder, Aramid fiber, Replacement.

INTRODUCTION

The majority of civil engineering structures are constructed of concrete, which is the fundamental building material. High-quality concrete is made with materials. Cement, fine aggregate, coarse aggregate, admixtures, chemical admixtures, and water make up concrete.

Dolomite is a carbonate mineral that is comprised of calcium magnesium carbonate CaMg (CO3)2. Dolomite is a mineral that forms rocks and is known for being extremely wettable and dispersible. Dolomite is impervious to enduring. In light of its unrivaled surface hardness and thickness, dolomite is a leaned toward building material. In the M30 grade concrete sample, dolomite powder was used to replace 5, 10, 15, 20, and 25% of the cement.

Aramid (fragrant polyamide) is a man-made polymeric substance with a high modulus that was found in 1965. By the mid 1970s, the strands were being delivered for business Applications. Aramid fibers outperform other synthetic fibers like nylon and polyster in their resistance to chemicals and the environment, their high tensile strength, high stiffness, low density, low creep, and high stress at rupture.

DOLOMITE POWDER:

Rock-forming minerals include dolomite powder. Calcium and magnesium carbonate, or CaMg (CO3)2, make up dolomite powder, a carbonate ingredient. It is the primary component of metamorphic and sedimentary rocks, respectively known as dolomitic marble and dolostone. In gas hydrate-bearing saturated lagoons and basins, dolomite is formed anaerobically.

By use of dolomite powder decreased the admission of development actually. The possibility of dolomite powder as a cement substitute is the subject of a research project.

Examples of M30 mix concrete are made by replacing 5, 10, 15, and 20. and 25 percentage of cement's weight in dolomite powder. Harden characteristics were identified and compared to traditional harden characteristics at 7 and 28 days.

Compositional Chemistry:

Dolomite contains calcium oxide (CaO), silica oxide (SiO_2), ferric oxide (Fe_2O_3) and magnesium oxide (MgO), aluminum oxide (Al_2O_3) and manganese oxide (MnO). The following describes the composition in terms of weight percentage.

Table:-1. Dolomite Powder Chemical Composition

Compounds	Composition (weight%)
CaO	80.21
Al_2O_3	1.52
SiO_2	2.50
MgO	15.50
CuO	0.07
MnO	0.02
Fe_2O_3	15.50

- Due to higher surface hardness and density, dolomite powder is preferred for building materials.
- It is generally accepted that the filling and expansion effect of adding dolomite powder can improve mechanical performance by enhancing the cement stone's pore structure.
- Due to its toughness, density, and superior resistance to weathering, dolomite is utilized in a variety of building construction and building invention applications.
- Dolomite powder in concrete to lower the cost of product and possibly improve its strength.
- Dolomite is resistant to weathering well.

Figure-1: Dolomite Powder

OBJECTIVES:

The current problem is structured as a study on partial replacement of OPC with Dolomite Powder and addition of Aramid-Fiber in concrete based on the above-mentioned literatures.

The following objectives are derived from literature reviews:

1. To increase the mechanical qualities of concrete such as compressive, split tensile, and flexural strength.
2. To improve concrete workability.
3. To reduce worldwide cement usage in construction.
4. Determine the best dolomite powder substitution proportion in concrete mix.

MATERIALS:

Concrete is a folio, a substance that sets and solidifies independently and ties different materials together. Cements come in many different varieties on the market. Concrete is the most usually utilized concrete. 53 distinct Portland cement grades were required for the project. Portland concrete has a particular gravity of 3.15.

Fine Total: The aggregate's primary function is to contribute to the mixture's workability and uniformity. The fine aggregate also aids in the cement paste's ability to hold the coarse aggregate particle in place. This prevents paste and coarse aggregate segregation and increases mixture flexibility.

Gritty Aggregate: Concrete's most crucial component is coarse aggregate. Synthetically, it is a steady substance. Drying shrinkage and other dimensional differences brought on by moisture migration are lessened when coarse aggregate is present. As coarse total in concrete, hard broke rock stones were utilized.

Calcium magnesium carbonate $(CA\ Mg)_2$ makes up the carbonate substance known as dolomite powder. The name additionally alludes to the sedimentary carbonate rock dolostone. Dolostone, also known as dolomite rock, is mostly made of the mineral dolomite and has a stoichiometric ratio of at least 50% magnesium to calcium by swapping, which is a common result of digenesis. Dolomite is a mineral that forms rocks and is known for its moderate oil and plasticizer absorption, exceptional wettability, and dispensability.

Aramid fibers are aromatic polyamide fibers that are directly bonded to their two aryl groups by more than 85% of the amide linkages. Lightweight, high-strength, high-modulus, high-temperature opposition, and unrivaled erosion obstruction are a portion of the advantages of this sort of fiber.
Yellow-colored para-aramid fibers are used in this experiment. All through the trial, a steady of 0.1% fiber was utilized for a volume of cement.

ARAMID-FIBER:

Aramid filaments are fragrant polyamide strands, containing over 85% amide bonds straightforwardly associated with the two aryls. The benefits of this type of fiber are as follows:
Low weight, high stength high modulus, resistance to high temperatures, and superior resistance to corrosion five to ten

percent more mechanical properties than synthetic fibers. Such strands are regularly utilized in composite designs The aramid fiber begins from sweet-smelling polyamide (aramids) and relies upon paraphenylene teraphthalamide, which presents an amide gathering and benzene rings into polyamide particles together. Because of solid between chain holding and an elevated degree of crystallization, modulus and tirelessness of these strands are exceptionally high (Chen and Zhou). In aramid filaments, 85% of amide linkages are straightforwardly appended to two fragrant rings. These fibers are used to make bulletproof vests, rope for offshore oil rigs, aircraft, and automobile parts. Under cyclic loading, aramid fibers are abrasion resistant.

According to Jassal and Ghosh, they are heat-resistant and five times stronger than steel. The elasticity is somewhere in the range of 2400 and 3600 N/mm2 with rate lengthening of 2.2% to 4.4%. 60 to 120 GPa is the tensile modulus. Granata and Parvin worked on strengthening the beam-column joint with Kevlar fiber, a type of aramid fiber. Shell compound epoxy was

utilized as a cement in this review. Kevlar fabric, an aramid fiber with tensile strength 55% higher than E-glass fiber and shear strength 180% higher than E-glass fiber, was used by Pereira and Revilock. The fabric has a bulk density of 1.44 g/cm3 and a linear density of 1.656 103 g/cm^3, respectively, which is the mass per unit of length. This study makes use of a plain weave woven bidirectional aramid fabric. This fiber has a area weight of 300 g/m^2. The dry fabric has a thickness of 0.25 millimeters.

Production:

In 2002, approximately 41,000 tons of aramid fiber were produced annually; in 2007, that number increased to 55,000 tons, and it continues to rise at a rate of 5% to 10% annually. The initial preparation of polymer begins with the amine-carboxylic acid halide group reaction.

n NH2-Ar-COCl- (NH-Ar-CO) N-+ n HCL (p-phenylene terephthalamides PPTA) Cosolvents and ionic components are used to make the subsequent polymer. Aramid fiber is produced by spinning the dissolved polymer into solid fiber to forms liquid chemical blend after polymer formation. For turning polymer anhydrous sulphuric corrosive is utilized.

Viewpoint Proportion:

The term "aspect ratio" refers to a ratio of the fiber's length to its diameter, which is typically expressed as greater than 1. In this experimental study, a constant of 0.25 percent fiber was used. Perspective proportion of various types of aramid fiber are recorded beneath.

1. Aramid Fiber - 14
2. Aramid Pulp - 29
3. Aramid Powder - 193
4. Short Aramid Fibers – 333

Characteristics:

- Good Resistance to Abrasion.
- Good Resistance to Organic Solvent.
- Melting Point is Very High.
- Low Flammability.
- Sensitive to Acids and Salts.
- Sensitive to Ultraviolet Radiation.
- Tenacity is High.
- Creep is Lower.

APPLICATION:

- Composite Materials.
- Flame Resisting Clothing.
- Asbestos Replacement.
- Cables and Ropes.
- Reinforced Thermoplastic Pipes.
- Fiber Reinforced Concrete.
- Asphalt Reinforcement.

Table-2: Physical Properties of Cement

Sl. No.	Property	Results	Standards
1	Relative Density	3.148	3.1-3.15
2	Fineness	4.24%	<10%
3	Initial Setting Time	42min	Not less than 30min
4	Final Setting Time	240min	Not greater than 600min
5	Standard Consistency	33%	30-35%

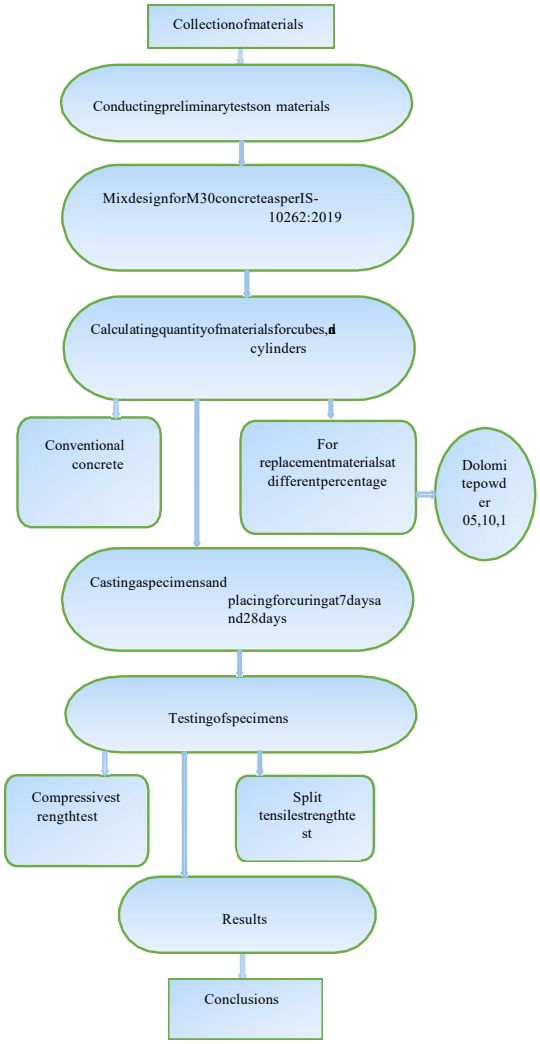
Table-3: Physical properties of fine aggregate

Sl. No.	Property	Results	IS Standards
1	Relative Density	2.68	IS:2386-1963 (2.65-2.70)
2	Finesse Modulus	3.08	IS:383-1970 (2.0-3.5)
3	Bulk Density	1.49 g/cm^3	IS:383-1970 (1.52-1.68g/cm3)
4	Zone	II	IS:383-1970
5	Water Absorption	0.5%	IS 2386-1963

Table-4: Physical Properties of Coarse Aggregates

	Property	Results
1	Relative density	2.85
2	Fineness modulus	6.15
3	Bulk density	1.58g/cm^3
4	Water absorption	0.42%

METHODOLOGY



Results and Discussions:

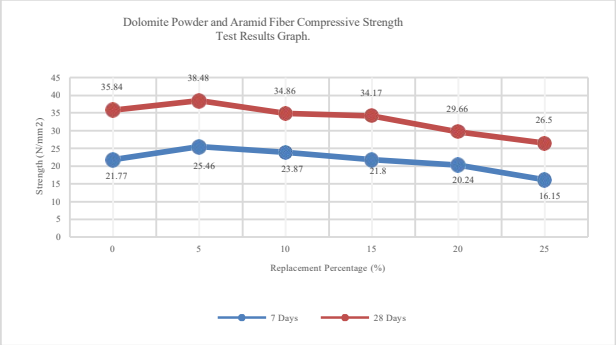
Fig-2: Split Tensile Strength Testing Machine

Fig-3: Compressive Strength Testing Machine

Dolomite Powder and Aramid Fiber Compressive Strength Test Results:

Percentage(%)	CompressiveStrength(N/mm²)	
	7 Day	28 Days
00	21.77	35.84
05	29.91	36.48
10	23.87	34.86
15	21.80	34.17
20	20.24	29.66
25	16.15	26.50

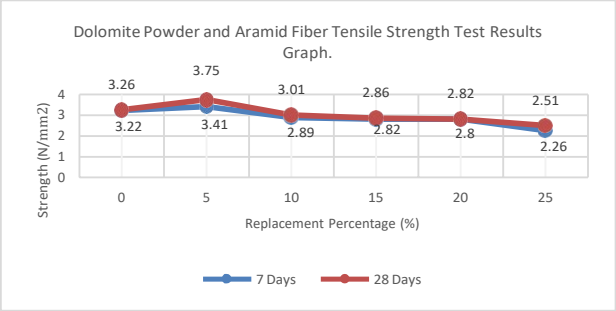
The Above Tabulated Results are Graphically Represented in Below Graphs.



Dolomite Powder and Aramid Fiber Split Tensile Strength Test Results:

Percentage(%)	Strength(N/mm²)	
	7 Day	28 Days
00	3.22	3.26
05	3.41	3.75
10	2.89	3.01
15	2.82	2.86
20	2.80	2.82
25	2.26	2.51

The Above Tabulated Results are Graphically Represented in Below Graphs.



CONCLUSION:

Experimental investigation is done by substituting the dolomite powder and adding Aramid Fiber. After the experimental investigation the above results are obtained. From the above results following conclusion are derived which is listed below.

- The substitution of cement by dolomite powder increase the concrete strength at certain proportion.
- The optimum substitution percentage is obtained when dolomite is 05% and 95% cement.
- At 05% replacement the maximal increment in the 28th day compression and split tensile strength were found.
- Cost of the dolomite powder is less than cement hence dolomite powder decreases the cost of concrete as well as pollution.

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