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EXPERIMENTAL INVESTIGATION ON CONCRETE WITH DUNITE POWDER AND ALCCOFINE 1203

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ABSTRACT

Concrete is a widely used construction material, and continuous efforts are made to enhance its properties and sustainability. This study investigates the partial replacement of cement in concrete mixes with two supplementary cementitious materials: Accofine 1203 and Dunite powder. A constant percentage of 7.5% Accofine 1203 will be utilized to assess its impact on concrete's fresh and hardened state properties. Concurrently, varying percentages of Dunite powder will partially replace cement to determine its optimal inclusion level for improved strengthand workability. The research aims to understand the synergistic effects of these materials on the overall performance of concrete, contributing to more sustainable and high-performance concrete formulations.Test for compressive strength and split tensile strength for 7 and 28 days.

KEYWORDS:Dunite Powder, Alccofine 1203, Sustainable,Compressive strength and Split tensile strength

1. INTRODUCTION

Concrete stands as one of the most fundamental and widely utilized construction materials globally, surpassed only by water in terms of consumption. It is a composite material primarily composed of cement, aggregates (like sand and gravel), and water. Through a chemical process called hydration, the cement reacts with water, forming a hardened paste that binds the aggregates together into a durable, stone-like mass.Its remarkable versatility, strength, and durability have made concrete the backbone of modern infrastructure. From towering skyscrapers and vast road networks to intricate bridges, dams, and residential buildings, concrete provides the essential structural integrity and long-term performance required for diverse applications. Its ability to be molded into virtually any shape when fresh, combined with its resistance to heavy loads, fire, and harsh environmental conditions, contributes significantly to its widespread adoption.

Alccofine 1203 is a highly specialized and innovative supplementary cementitious material (SCM) used in concrete technology. It is a proprietary product, primarily composed of low calcium silicates, and is derived from

processed slag with a high glass content. What sets Alccofine 1203 apart is its ultra-fine particle size, which is significantly smaller than that of cement, fly ash, or silica fume, typically ranging from 4 to 6 microns.This optimized particle size distribution is crucial to its performance, allowing it to fill the microscopic voids within the cement paste, leading to a denser and less porous concrete matrix.Alccofine 1203 exhibits both latent hydraulic and pozzolanic properties.This means it not only reacts with water similarly to cement but also consumes the calcium hydroxide released during cement hydration, forming additional calcium silicate hydrate (C-S-H) gel. The result is enhanced strength, improved durability, and increased resistance to various aggressive environmental agents. Its inclusion also contributes to better workability, reduced water demand, and extended slump retention in fresh concrete, making it particularly beneficial for high-performance and special-purpose concrete applications like high-rise structures, self-compacting concrete, and shotcrete.

Dunite powder is a finely ground form of dunite, an ultramafic igneous rock primarily composed of the mineral olivine, along with minor amounts of other minerals like pyroxene and chromite. This naturally occurring magnesium-rich rock has garnered increasing interest in the construction industry as a potential partial replacement for cement. Its finely divided nature allows it to act as a micro-filler, contributing to a denser concrete matrix.While not inherently hydraulic like cement, dunite powder can exhibit pozzolanic properties, especially when finely ground or subjected to thermal activation. This means it can react with calcium hydroxide (a byproduct of cement hydration) to form additional calcium silicate hydrate (C-S-H) gel, which is the primary strength-giving component in concrete.

2. OBJECTIVES

To determine the optimal partial replacement percentage of cement with Dunite powder by evaluating its influence on the mechanical properties (compressive and tensile strength) and microstructural characteristics of concrete.

3. MATERIALS

3.1 Cement: Cement is a finely ground powdery substance, typically made from limestone and clay, that acts as a binding agent. When mixed with water, it undergoes a chemical reaction (hydration) to form a hardened paste, essential for binding aggregates in concrete and mortar.

3.2 Fineaggregate:Fine aggregate in civil engineering refers to granular material primarily consisting of sand, crushed stone, or crushed slag, with particles typically **passing through a 4.75 mm sieve** and generally **retained on a 0.075 mm sieve**. It plays a crucial role in concrete mixes by filling the voids between coarse aggregates, improving workability, enhancing density, and contributing to the overall strength and smooth finish of the hardened concrete.

3.3 Coarse aggregate: Coarse aggregate refers to granular material, such as gravel or crushed stone, with particles primarily **retained on a 4.75 mm sieve**. It provides the bulk, strength, and structural stability to concrete and asphalt mixes.

3.4 Water: Water plays a dual and critical role in concrete: it chemically reacts with cement in a process called hydration to form the hardened binding paste, and it lubricates the mix to provide workability, allowing for proper placement and finishing.

3.5Dunite Powder: Dunite powder is a finely ground form of dunite, an ultramafic igneous rock composed predominantly of olivine (over 90%). It's gaining attention in construction as a potential partial cement replacement. When finely pulverized, it can exhibit pozzolanic properties, reacting with cement hydration byproducts to improve concrete strength and durability.

3.6 Alccofine 1203: Alccofine 1203 is an ultra-fine, highly reactive supplementary cementitious material, primarily composed of processed slag.Its extremely small particle size enhances concrete properties by filling voids and promoting further hydration, leading to increased strength and durability.

4. EXPERIMENTAL RESULTS

4.1 Compressive strength

The compressive strength test measures the maximum load a material, like concrete, can withstand under compression before it fails or deforms. This is typically done by gradually applying force to a standardized specimen cube in a testing machine for 7 and 28 days.

Table 1: Compressive strength results of concrete with Alccofine 1203 anddifferent percentages of Dunite Powder used as a partial replacement for cement.

Sl.no	7.5% of Alccofine 1203 +% of Dunite Powder	Compressive Strength Results, N/mm^2	
		7 days	28 days
1	0%	27.07	39.52
2	7.5%Af+20% Dp	32.19	46.59
3	7.5%Af+20% Dp	33.32	47.61
4	7.5%Af+20% Dp	31.68	46.18

4.2 Split tensile strength

The split tensile strength test is an indirect method used to determine the tensile strength of brittle materials like concrete. It involves placing a cylindrical specimen horizontally and applying a compressive load diametrically along its length, causing the cylinder to split along the loaded diameter due to induced tensile stresses.To cracking in concrete constructions for 7 and 28 days.

Table 2: Split tensile strength results of concrete with Alccofine 1203 anddifferent percentages of Dunite Powder used as a partial replacement for cement.

Sl.no	7.5% of Alccofine 1203 +% of Dunite Powder	Split tensile Strength Results, N/mm^2	
		7 days	28 days
1	0%	2.71	3.97
2	7.5%Af+20% Dp	3.22	4.63
3	7.5%Af+20% Dp	3.51	4.86
4	7.5%Af+20% Dp	3.17	4.54

5. CONCLUSION

1. The normal concrete compressive strength results for 7 days and 28 days is27.07N/mm^2 and 39.52 N/mm^2.
2. For concrete mixes with a constant 7.5% Alccofine 1203 and 20% Dunite powder as partial cement replacements, the **7-day and 28-day compressive strength results** were determined is 33.32N/mm^{2}and 47.61N/mm^2.
3. The normal concrete split tensile strength results for 7 days and 28 days is 2.71 N/mm^2 and 3.97 N/mm^2.
4. For concrete mixes with a constant 7.5% Alccofine 1203 and 20% Dunite powder as partial cement replacements, the **7-day and 28-day split tensile strength results** were determined is 3.51 N/mm^{2}and 4.86 N/mm^2.

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