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EXPERIMENTAL INVESTIGATION ON CONCRETE WITH DUNITE POWDER AND ALCCOFINE 1203

[1]DR.K.CHANDRAMOULI, [2] J.SREE NAGA CHAITANYA, [3] VARALAKSHMI,[4]SK NAYEEM BASHA

[1]Professor & HOD, [2]Assistant Professor, [3,4] B.Tech Student

[1,2,3 &4] Department of Civil Engineering, NRI Institute of Technology, Visadala (V), Medikonduru (M), Guntur, Andhra Pradesh, INDIA

Email: koduru_mouli@yahoo.com jarugumillichaitanya1989@gmail.com

ABSTRACT

Concrete is a commonly utilized building material, and ongoing efforts are being made to improve its characteristics and sustainability. This research explores the partial substitution of cement in concrete mixtures using two supplementary cementitious materials: Accofine 1203 and Dunite powder. A fixed amount of 7.5% Accofine 1203 will be employed to evaluate its effects on the fresh and hardened properties of concrete. At the same time, varying amounts of Dunite powder will be used to partially replace cement, aiming to identify its optimal inclusion level for enhanced strength and workability. The study seeks to explore the combined effects of these materials on the overall performance of concrete, thereby contributing to the development of more sustainable and high-performing concrete formulations.Test for compressive strength and split tensile strength for 28,56 and 90 days.

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

1. INTRODUCTION

Concrete is one of the most essential and commonly used construction materials around the world, only surpassed by water in terms of overall usage. It is a composite substance mainly made up of cement, aggregates such as sand and gravel, and water. When water is added to cement, a chemical process known as hydration occurs, creating a solidified paste that binds the aggregates into a sturdy, stone-like material. Its exceptional versatility, strength, and durability have established concrete as the foundation of contemporary infrastructure. Whether in the form of towering skyscrapers, extensive road systems, or elaborate bridges, dams, and homes, concrete offers the necessary structural stability and longevity needed for a wide range of uses. Its capacity to be shaped into nearly any configuration while still fresh, alongside its strength against heavy loads, fire, and severe weather conditions, is a key factor in its extensive use.

Alccofine 1203 is a cutting-edge and specially designed supplementary cementitious material (SCM) utilized in concrete technology. It is a proprietary formulation mainly made up of low calcium silicates and is produced from processed slag with a high glass content. What distinguishes Alccofine 1203 is its extremely fine particle size, which is much smaller than that of cement, fly ash, or silica fume, typically falling between 4 to 6 microns. This carefully optimized particle size distribution is vital for its effectiveness, enabling it to occupy the tiny voids within the cement paste and resulting in a denser and less permeable concrete structure. Alccofine 1203 demonstrates both latent hydraulic and pozzolanic characteristics.This implies that it not only interacts with water in a manner similar to cement but also utilizes the calcium hydroxide produced during the hydration process, leading to the generation of additional calcium silicate hydrate (C-S-H) gel. The outcome is improved strength, enhanced durability, and greater resistance to a variety of aggressive environmental factors. Its addition also aids in better workability, lower water requirements, and prolonged slump retention in fresh concrete, making it especially advantageous for high-performance and specialized concrete applications such as high-rise buildings, self-compacting concrete, and shotcrete.

Dunite powder is a finely milled version of dunite, an ultramafic igneous rock mainly consisting of the mineral olivine, along with trace amounts of other minerals such as pyroxene and chromite. This naturally occurring magnesium-rich rock has gained more attention in the construction sector as a potential partial substitute for cement. Its finely ground form allows it to serve as a micro-filler, enhancing the density of the concrete matrix. Although it is not hydraulic like cement, dunite powder can display pozzolanic characteristics, particularly when finely ground or thermally treated. This means it has the ability to react with calcium hydroxide (a byproduct produced during cement hydration) to generate additional calcium silicate hydrate (C-S-H) gel, which is the key component responsible for strength in concrete.

2. OBJECTIVES

To assess the ideal percentage of cement substitution with Dunite powder by examining its effect on the mechanical properties (compressive and tensile strength) and microstructural features of concrete.

3. MATERIALS

3.1 Cement: Cement is a finely milled powdery material, usually derived from limestone and clay, that serves as a bonding agent. When combined with water, it undergoes a chemical process known as hydration, resulting in a solid paste that is vital for binding aggregates in both concrete and mortar.

3.2 Fine aggregate:In civil engineering, fine aggregate refers to granular materials primarily made up of sand, crushed stone, or crushed slag, with particle sizes typically passing through a 4.75 mm sieve and generally being retained on a 0.075 mm sieve. It is essential in concrete mixes as it fills the gaps between coarse aggregates, enhances workability, increases density, and contributes to the overall strength and smooth finish of the cured concrete.

3.3 Coarse aggregate: Coarse aggregate consists of granular substances, like gravel or crushed stone, with particles that are mainly held back by a 4.75 mm sieve.

3.4 Water: It contributes to the volume, strength, and structural integrity of concrete and asphalt mixtures. Water serves two essential functions in concrete: it chemically interacts with cement through a process known as hydration, creating a solid binding paste, and it acts as a lubricant for the mix, facilitating proper placement and finishing.

3.5Dunite Powder: Dunite powder is a finely milled version of dunite, a type of ultramafic igneous rock that is predominantly made up of olivine (more than 90%). It is gaining recognition in construction as a viable partial substitute for cement. When it is finely ground, it can demonstrate pozzolanic characteristics, reacting with byproducts of cement hydration to enhance the strength and durability of concrete.

3.6 Alccofine 1203: Alccofine 1203 is an ultra-fine, highly reactive supplementary cementitious material that is chiefly made from processed slag. Its very small particle size improves concrete characteristics by filling gaps and encouraging additional hydration, resulting in enhanced strength and durability.

4. EXPERIMENTAL RESULTS

4.1 Compressive strength

The compressive strength test assesses the greatest load that a material, such as concrete, can endure under compression before it either fails or deforms. This is usually performed by incrementally applying force to a standard specimen cube within a testing apparatus for 28,56 and 90 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		
		28 days	56 days	90 days
1	0%	39.52	42.93	45.95
2	7.5%Af+20% Dp	46.59	50.76	54.45
3	7.5%Af+20% Dp	47.61	51.53	55.63
4	7.5%Af+20% Dp	46.18	50.31	54.02

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 28,56 and 90 days.

Table 2: Split tensile strength results of concrete with Alccofine 1203 and different 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		
		28 days	56 days	90 days
1	0%	3.97	4.29	4.62
2	7.5%Af+20% Dp	4.63	5.03	5.38
3	7.5%Af+20% Dp	4.86	5.28	5.67
4	7.5%Af+20% Dp	4.54	4.91	5.29

5. CONCLUSION

1. The normal concrete compressive strength results for 28,56 and 90 days is39.52 N/mm^2, 42.93 N/mm^{2}and 45.95 N/mm^2.
2. For concrete mixes with a constant 7.5% Alccofine 1203 and 20% Dunite powder as partial cement replacements, the 28,56 and 90 days **compressive strength results** were determined is 47.61 N/mm^2,51.53 N/mm^2 and 55.63 N/mm^2.
3. The normal concrete split tensile strength results for 28,56 and 90 days is 3.97 N/mm^2,4.29 N/mm^2 and 4.62 N/mm^2.
4. For concrete mixes with a constant 7.5% Alccofine 1203 and 20% Dunite powder as partial cement replacements, the 28,56 and 90 days **split tensile strength results** were determined is 4.86 N/mm^2, 5.28 N/mm^2 and 5.67 N/mm^2.

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