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Mechanical Properties of Chebula Powder Concrete with Alccofine 1203

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ABSTRACT: The present study investigates the mechanical properties of concrete incorporating *Terminalia chebula* powder and Alccofine 1203 as partial replacements for cement. Chebula powder, a natural bio-admixture, and Alccofine 1203 an ultra-fineslad-based material, were used to enhance strength and durability. M30 grade concrete were prepared with varying percentages of chebula powder from 0% to 20% and Alccofine 1203 from 0% to 15%. Specimens were tested for compressive strength, split tensile strength and ultrasonic pulse velocity at 7 and 28 days of curing. Results indicate that the addition of both materials significantly improved the mechanical performance compared to conventional concrete.

The pozzolanic activity of Alccofine and the organic compounds in chebula powder contribute to denser microstructure and better hydration. Compressive strength and split tensile strength showed progressive increases upto optimum dosage levels. UPV test results confirmed quality improvement, indicating reduced voids and enhanced homogeneity of . The maximum strength was achieved at 15% replacement of cement with chebula powder and 10% replacement of Alccofine 1203. Thus, chebula powder with Alccofine 1203 proves to be effective sustainable blend for producing high-strength eco-friendly concrete.

KEYWORDS: Chebula Powder, Alccofine 1203, homogeneity, pozzolanic, Compressive strength and Split tensile strength.

I. INTRODUCTION

Concrete is an important construction material that has significantly contributed to the development of modern infrastructure and building methods. Made from a mixture of cement, aggregates, water, and additives, concrete provides an outstanding mix of strength, longevity, and adaptability.

Alccofine – 1203, referred to as polycofine, is a material that acts as an additive in cement. It is commonly utilized in the building sector. Alccofine-1203 is a finely powdered, highly reactive substance created from the combustion of rice husks. ALCCOFINE-1203 is classified as a pozzolan. To put it differently, it is a substance that interacts with calcium hydroxide in water to produce a cement-like compound.

Chebula powder is derived from the dried fruit of the *Terminalia chebula* tree, commonly known as **Haritaki**. Regarded as the "King of Medicines" in Ayurveda, it is a versatile herbal supplement used for centuries in traditional Asian medicine. The fruit is harvested when ripe, dried, and ground into a fine, brownish-yellow powder with a bitter, astringent, and slightly sweet taste. It contains high levels of tannins, chebulinic acid, and antioxidants like vitamin C and flavonoids.

II. OBJECTIVES

1. To evaluate the effect of terminalia cedula powder and Alccofine 1203 on the compressive strength of concrete at 7 and 28 days of curing.
2. To assess the influence of varying percentages of chebula powder and Alccofine 1203 on the split tensile strength of concrete.
3. To determine the quality and homogeneity of concrete using ultrasonic pulse velocity test for different mix proportions.
4. To identify the optimum replacement percentage of chebula powder and Alccofine 1203 that gives maximum improvement in mechanical properties of concrete.

III. MATERIALS

a. Cement: Cement is a substance that has both adhesive and cohesive qualities. When combined with mineral fragments and water, cement binds the particles into a solid mass. This description encompasses a significant quantity of cementing materials. For construction purposes, cement is used to bind materials such as stones, sand, and bricks. Our study focuses on cement used in construction, especially for concrete applications.

b. Fine aggregate: Fine aggregates are essentially any natural sand particles won from the land through the mining process. Fine aggregates consist of natural sand or crushed stone with most particles passing through a 3/8-inch sieve. Fine aggregate, which is often formed of sand, crushed stone, or gravel with particles smaller than 4.75 mm, is the basis for concrete mixes.

c. Coarse aggregate: coarse aggregate with a maximum size of 20mm was utilized. The aggregates were washed to eliminate dust and dirt and then dried to a surface-dry state. The aggregates were tested in accordance with IS:383-1970.

d. Water: Water that is appropriate for drinking is generally acceptable for use in concrete. Water from lakes and streams that harbor marine life is typically also suitable. If water is sourced from the above-mentioned sources, sampling is not required. Water plays a crucial role in hydrating the concrete that forms the coupling lattice, holding the dormant components suspended in a medium until the structure hardens; it also acts as a lubricant between fine and coarse aggregates, enabling the concrete to be workable.

e. Chebula Powder : Kadukkai (*Terminalia chebula*) was used as a natural admixture, and its impact on the properties of conventional concrete was studied. Herbal admixtures are environmentally friendly and certainly enhance the durability and strength of concrete.

f. Alccofine 1203 : ALCCOFINE 1203 is a commonly used supplementary cementitious material in construction. It is a finely textured, highly reactive powder produced by burning rice husk. ALCCOFINE 1203 is a pozzolanic material, meaning it combines with calcium hydroxide in the presence of water to produce cementitious compounds.

IV. RESULTS AND DISCUSSION

a. Compressive strength test: 150 x 150 x 150 mm cube specimens were cast, and for varying concrete mix proportions, they were tested in a compression testing equipment for seven and twenty-eight days of curing time.

Table 1:- Compressive Strength result of concrete with chebula powder as partial replacement of cement.

S.No	% of Chebula Powder	Compressive Strength Results, N/mm ²	
		7 days	28 days
1	0%	27.19	39.13
2	5%	28.44	41.52
3	10%	29.86	43.34
4	15%	31.42	45.54
5	20%	30.55	44.22

Table 2:- Compressive Strength result of concrete with Alccofine as partial replacement of cement.

S.No	% of Alccofine	Compressive Strength Results, N/mm ²	
		7 days	28 days
1	0%	27.19	39.13
2	5%	30.42	44.41
3	10%	34.71	49.24
4	15%	31.88	45.62

Table 3:- Combined Compressive Strength result of concrete.

S.No	Combined Replacement(s)	Compressive Strength Results, N/mm ²	
		7 days	28 days
1	0%	27.19	39.13
2	15% CP+10% AF	36.73	52.41

b. Split tensile strength: Age of 7 and 28days, In this procedure, a standard cylindrical specimen—measuring 300 mm in length and 150 mm in diameter—is positioned horizontally between the loading platens of a Compression Testing Machine (CTM). A compressive load is applied diametrically and uniformly across the cylinder's length until it fails along its vertical diameter.

Table 4:- Split tensile Strength result of concrete with chebula powder as partial replacement of cement.

S.No	% of Chebula Powder	Split tensile Strength Results, N/mm ²	
		7 days	28 days
1	0%	2.62	3.36
2	5%	2.78	4.08
3	10%	3.01	4.32
4	15%	3.35	4.78
5	20%	3.08	4.41

Table 5:- Split tensile Strength result of concrete with Alccofine as partial replacement of cement.

S.No	% of Alccofine	Split tensile Strength Results, N/mm ²	
		7 days	28 days
1	0%	2.62	3.86
2	5%	2.98	4.59
3	10%	3.77	5.36
4	15%	3.18	4.56

Table 6:- Combined Split tensile Strength result of concrete.

S.No	Combined Replacement(s)	Split tensile Strength Results, N/mm ²	
		7 days	28 days
1	0%	2.62	3.86
2	15% CP+10% AF	4.11	5.89

C. Ultrasonic pulse velocity: The testing apparatus consists of an electrical pulse generator, an amplifier, and a pair of transducers—a transmitter and a receiver—that are typically applied to opposite faces of a member for the most accurate "direct" transmission results. If only one face is accessible, indirect or surface transmission can be used, though it requires specific calibration.

Table 7:- Ultra Pulse Velocity result of concrete with chebula powder as partial replacement of cement.

S.No	% of Chebula Powder	Ultra Pulse Velocity Results, m/s	
		28 days	Quality
1	0%	4351	Good
2	5%	4528	Excellent
3	10%	4631	Excellent
4	15%	4771	Excellent
5	20%	4671	Excellent

Table 8:- Ultra Pulse Velocity result of concrete with Alcofine as partial replacement of cement.

S.No	% of Alcofine	Ultra Pulse Velocity Results, m/s	
		28 days	Quality
1	0%	4351	Good
2	5%	4562	Excellent
3	10%	4796	Excellent
4	15%	4624	Excellent

Table 9:- Combined Ultra Pulse Velocity result of concrete.

S.No	Combined Replacement(s)	Ultra Pulse Velocity Results, m/s	
		28 days	Quality
1	0%	4351	Good
2	15% CP+10% AF	5009	Excellent

V. CONCLUSION

1. The compressive strength for conventional concrete for 7 and 28 days is 27.19 and 39.13 N/mm².
2. At 15% replacement of cement with chebula powder the compressive strength for 7 and 28 days is 31.42 and 45.54 N/mm².
3. At 10% replacement of cement with Alccofine the compressive strength for 7 and 28 days is 34.71 and 49.24 N/mm².
4. At 15%CP+10% AF the combined replacement of concrete the compressive strength for 7 and 28 days is 36.73 and 52.41 N/mm².
5. The Split tensile strength for conventional concrete for 7 and 28 days is 2.62 and 3.86 N/mm².
6. At 15% replacement of cement with chebula powder the compressive strength for 7 and 28 days is 3.35 and 4.78 N/mm².
7. At 10% replacement of cement with Alccofine the compressive strength for 7 and 28 days is 3.77 and 5.36 N/mm².
8. At 15%CP+10% AF the combined replacement of concrete the compressive strength for 7 and 28 days is 4.11 and 5.89 N/mm².
9. The Ultra pulse velocity for conventional concrete for 28 days is 4351 m/s.
10. At 15% replacement of cement with chebula powder the Ultra pulse velocity for 28 days is 4771m/s.
11. At 10% replacement of cement with Alccofine the Ultra pulse velocity for 28 days is 4796 m/s.
12. At 15%CP+10% AF the combined replacement of concrete the Ultra pulse velocity for 28 days is 5009 m/s.

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