

Experimental Investigation on Baggasse Ash Concrete with Chebula Powder

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ABSTRACT: This study checks how well concrete works when we replace some cement with sugarcane bagasse ash and Terminalia chebula powder. Bagasse ash is a farm waste that acts like a pozzolan, and chebula powder is a natural mix we used to make the concrete more eco-friendly. We made M40 grade concrete with bagasse ash from 0% to 20%, and chebula powder from 0% to 20% at 15% the optimum strength increases. Both additives improved strength due to better pozzolanic reaction and micro-filling, with the best results at 15 % replacements. The test for determined for 7 and 28 days of compressive strength and split tensile strength and ultrasonic pulse velocity.

KEYWORDS: Chebula Powder, Baggasse Ash, Compressive strength and Split tensile strength.

I. INTRODUCTION

Concrete is composite construction material made by mixing cement, fine aggregate, coarse aggregate and water in specific proportions.

The search for sustainable, green infrastructure has forced the construction industry to evaluate industrial and agricultural waste materials as alternatives to traditional elements. Sugarcane bagasse ash (SCBA) has emerged as a highly promising supplementary cementitious material (SCM) capable of partially replacing ordinary Portland cement. Bagasse itself is the fibrous waste leftover after crushing sugarcane stalks to extract juice in processing mills. Modern construction technology is aggressively researching organic bio-admixtures to formulate sustainable concrete alternatives that bypass chemical pollution. Terminalia chebula—widely recognized as haritaki, black myrobalan, or kadukkai—presents a highly effective, renewable plant-derived admixture for contemporary concrete matrix modification. Historically used to fortify historical structural mortars, the dried fruit of this tree is processed into an ultra-fine chebula powder for modern applications. The underlying mechanism altering the concrete performance stems from a massive concentration of bioactive compounds, including hydrolyzable tannins, chebulinic acid, and complex polyphenols.

II. OBJECTIVES

1. To evaluate the effect of bagasse ash as a partial fine aggregate replacement on the compressive strength of concrete at 7 and 28 days of curing for replacements levels from 0% to 20%.
2. To assess the influence of Terminalia chebula powder on the mechanical properties of concrete when used as a partial substitute for cement from 0 % to 20%.
3. To determine the optimum dosages of bagasse ash and chebula powder that gives maximum strength improvement compared to conventional concrete.

III. MATERIALS

- a. **Cement:** Cement is a fine, powdery binding material that sets and hardens when mixed with water through hydration.
- b. **Fine aggregate:** Fine aggregates consists of small, granular particles like natural sand or crushed stone that pass through a 4.75 mm sieve.
- c. **Coarse aggregate:** coarse aggregate larger particles like gravel or crushed stone retained on a 4.75mm sieve, usually up to 20mm for normal concrete.
- d. **Water:** Water initiates the chemical reaction of hydration with cement, which binds all the ingredients together and causes setting.
- e. **Chebula Powder:** Chebula powder is a natural bio-admixture made by grinding dried terminalia chebula powder fruit, commonly known as haritaki. As a partial cement substitute it helps in densifying the microstructure and can increase strength while lowering the carbon footprint. .
- f. **Bagasse Ash :** It is the residue left after burning sugarcane bagasse an agriculture waste from sugarmills. When used as a partial which fills voids between larger aggregates and contribute to denser mix due to their filler effect and slight pozzolanic action.

IV. RESULTS AND DISCUSSIONS:

- 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 7 and 28 days of curing time.

Table 1:- Compressive Strength Results of Concrete with Partial replacement of fine aggregate with Bagasse ash.

S.No	% of Baggage Ash	Compressive Strength Results, N/mm ²	
		7 days	28 days
1	0%	33.28	49.31
2	5%	34.95	51.26
3	10%	35.86	51.83
4	15%	37.76	53.87
5	20%	36.54	52.29

Table 2:- 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%	33.28	49.31
2	5%	35.95	52.35
3	10%	37.38	54.74
4	15%	40.43	57.68
5	20%	38.97	55.76

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%	33.28	49.31
2	15%BSh+15% CP	40.62	57.95

- b. **Split tensile strength:** 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 at 7 and 28 days.

Table 4:- Split tensile Strength Results of Concrete with Partial replacement of fine aggregate with Bagasse ash.

S.No	% of Bagasse Ash	Split tensile Strength Results, N/mm ²	
		7 days	28 days
1	0%	3.24	4.82
2	5%	3.46	5.11
3	10%	3.58	5.18
4	15%	3.93	5.54
5	20%	3.67	5.26

Table 5:- 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%	3.24	4.82
2	5%	3.55	5.25
3	10%	3.72	5.41
4	15%	4.11	5.76
5	20%	4.03	5.63

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%	3.24	4.82
2	15%BSh+15% CP	4.14	5.93

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 Results of Concrete with Partial replacement of fine aggregate with Bagasse ash.

S.No	% of Bagasse Ash	Ultra Pulse Velocity Results, m/s	
		28 days	Quality of Concrete
1	0%	4461	Good
2	5%	4576	Excellent
3	10%	4775	Excellent
4	15%	4839	Excellent
5	20%	4623	Excellent

Table 8:- Ultra Pulse Velocity Results of Concrete with Partial replacement of fine aggregate with Chebula Powder.

S.No	% of Chebula Powder	Ultra Pulse Velocity Results, m/s	
		28 days	Quality of Concrete
1	0%	4461	Good
2	5%	4597	Excellent
3	10%	4779	Excellent
4	15%	4864	Excellent
5	20%	4638	Excellent

Table 5.9:- Combined Ultra Pulse Velocity result of concrete.

S.No	Combined Replacement(s)	Ultra Pulse Velocity Results, m/s	
		28 days	Quality of Concrete
1	0%	4461	Good
2	15%BSH+15% CP	5068	Excellent

V. CONCLUSION

1. The compressive strength for conventional concrete for 7 and 28 days is 33.28 and 49.31 N/mm².
2. At 15% replacement of cement with baggase ash the compressive strength for 7 and 28 days is 37.76 and 53.87 N/mm².
3. At 15% replacement of cement with chebula powder the compressive strength for 7 and 28 days is 40.43 and 57.68 N/mm².
4. At 15%CP+15% BSH the combined replacement of concrete the compressive strength for 7 and 28 days is 40.62 and 57.95N/mm².
5. The Split tensile strength for conventional concrete for 7 and 28 days is 3.24 and 4.82 N/mm².
6. At 15% replacement of cement with baggase ash the Split tensile strength for 7 and 28 days is 3.93 and 5.54 N/mm².
7. At 15% replacement of cement with chebula powder the Split tensile strength strength for 7 and 28 days is 4.11 and 5.76 N/mm².
8. At 15%CP+15% BSH the combined replacement of concrete the Split tensile strength strength for 7 and 28 days is 4.14 and 5.93 N/mm².
9. The Ultra pulse velocity for conventional concrete for 28 days is 4461 m/s.
10. At 15% replacement of cement with baggase ash the Ultra pulse velocity for 28 days is 4839 m/s.
11. At 10% replacement of cement with chebula powder the Ultra pulse velocity for 28 days is 4864 m/s.
12. At 15%CP+15% BSH the combined replacement of concrete the Ultra pulse velocity for 28 days is 5068 m/s.

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