

Strengthening of Concrete by Zeolite Powder as Partial Replacement of Fine Aggregate and Coarse Aggregate with Bamboo Chips

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ABSTRACT

The use of zeolite powder as a partial substitute for cement in concrete is the main topic of this study. The major goal of this endeavor is to promote dietary supplement products as building materials. Zeolite powder is a naturally occurring substance created by the chemical interaction of volcanic ash and seawater. 28, 56, and 90 days were used for the curing process. But as we replaced more cement with zeolite powder, the compressive strength was rising. Natural pozzolanic material called zeolite is widely distributed in China. In this work, the mechanical characteristics of concrete incorporating bamboo chips as a potential supply of aggregates were examined. Compressive and tensile strengths are measured in this experiment. To reduce water absorption, a 0.5-cm-thick bamboo chip was chopped into a 1-cm-wide by 1-cm-high piece, dried, wetted, and coated. For 28, 56, and 90 days, the coarse aggregates in the concrete specimen were replaced with 0%, 5%, 7.5%, 10%, 12.5%, and 15% concrete for split tensile and compressive strength tests.

KEYWORDS: Zeolite powder, Bamboo Chips, Compressive strength, Split tensile strength.

1. INTRODUCTION

Concrete is the most often used building material in the world and is used for all types of structural development. With time and concrete reduction, concrete will support post and pre tensioning techniques to develop a greater strength. There are numerous ways to satisfy different needs, some of which may be more powerful than typical. Water, cement, coarse aggregate, and fine aggregate are the ingredients of concrete. When cement and water are joined, an exothermic reaction occurs that hardens the individual components of concrete. Zeolite is a mineral that develops from sedimentary ash in a natural process. Zeolite is created during an eruption when molten rock and volcanic ash combine with seawater. Silicon, aluminum, and oxygen are the three elements that make up the crystalline solid known as zeolite. They are capable of gas absorption, ion exchange, filtration, smell elimination,

and chemical sieving. The most typical use of zeolites is in water softeners. Because of its inherent qualities, bamboo is an easy-to-work-with replacement that can be bent and has a good strength to weight ratio. It is one of the rapidly increasing natural reserves that is accessible and nearby. Since the beginning of time, bamboo has been used for construction. Bamboo has a high economic potential, particularly in developing nations, because it can be regenerated in a very short period of time. A crucial evaluation of the current state and future prospects of Bamboo housing might be beneficial in realizing that potential.

2. OBJECTIVES

- a. To enhance the fine aggregate by using Zeolite powder.
- b. To make the best use of the coarse aggregate of bamboo chips.
- c. Tests on the strength and usability were analysed in order to determine how likely it was to be used.

3. MATERIALS:

- a. Cement:** Cement is typically used as a binder in concrete, a substance used in construction to link other components while it sets and hardens.
- b. Fine Aggregate:** Fine aggregate is the most crucial element of natural sand- or crushed stone-based concrete. The density and quality of the fine aggregate have a big impact on the concrete's hardened qualities.
- c. Coarse Aggregate:** Material remaining exceeding IS Sieve 4.75 mm is referred to as coarse aggregate. The typical maximum size increases by 10 to 20 mm, per IS 383:1970.
- d. Water:** Water is one of the most essential components in building, as it is required for several processes like creating mortar, mixing cement, and curing work. The quality of the water used directly affects both the durability of the motor and the cement concrete used in the construction project.
- e. Zeolite powder:** For use as a partial replacement for cement in concrete, it is also available in powder form. It is able to effectively absorb carbon dioxide from the atmosphere and has strong pozzolanic reactivity.
- f. Bamboo Chips:** Bamboo is renowned for being one of the plants with rapid growth because of its distinct rhizome-dependent structure.

4. RESULTS AND DISCUSSIONS:

- a. Compressive strength test:** For the compression strength test, a cube-shaped cast specimen of 150 mm by 150 mm by 150 mm is employed. After 28,56 and 90 days of curing in a water tank, the cast specimen's strength was assessed.

Table 1: Compressive Strength Results on Concrete by Partial Replacement of Zeolite Powder in Fine Aggregate.

S.No	% Of Zeolite Powder	Compressive Strength Results, N/mm ²		
		28 days	56 days	90 days
1	0%	49.26	53.45	57.51
2	5%	52.65	57.24	61.54
3	10%	55.28	60.12	64.63
4	15%	53.19	57.95	62.21

Table 2: Compressive Strength Results on Concrete by Partial Replacement of Bamboo Chips in Coarse Aggregate.

S.No	% Of Bamboo Chips	Compressive Strength Results, N/mm ²		
		28 days	56 days	90 days
1	0%	49.26	53.45	57.51
2	5%	50.19	54.46	58.66
3	7.5%	51.59	56.11	60.31
4	10%	52.22	56.72	61.07
5	12.5%	52.71	57.32	61.79
6	15%	51.86	56.51	60.67

Table3 :Combined Compressive strength Result of concrete by Partial replacement of 10% Zeolite Powder in Fine aggregate+ 12.5% Bamboo Chips in Coarse Aggregate

S.No	Combined replacements(%)	Compressive Strength Results, N/mm ²		
		28 days	56 days	90 days
1	0	49.26	53.45	57.51
2	10% ZP+12.5% BC	57.05	62.15	66.74

b. Split tensile strength test: The split tensile strength of cylindrical specimens (150 mm in diameter x 300 mm in height) was measured at ages of 28,56 and 90 days. A load is supplied to a cylindrical sample that is positioned horizontally between a compression testing machine's loading surface, and the load is maintained until the cylinder fails along its vertical diameter.

Table 4: Split tensile Strength Results on Concrete by Partial Replacement of Zeolite Powder in Fine Aggregate.

S.No	% Of Zeolite Powder	Split tensile Strength Results, N/mm ²		
		28 days	56 days	90 days
1	0%	4.43	4.81	5.17
2	5%	5.21	5.66	6.09
3	10%	5.37	5.83	6.27
4	15%	5.26	5.72	6.14

Table 5: Split tensile Strength Results on Concrete by Partial Replacement of Bamboo Chips in Coarse Aggregate.

S.No	% Of Bamboo Chips	Split tensile Strength Results, N/mm ²		
		28 days	56 days	90 days
1	0%	4.43	4.81	5.17
2	5%	4.95	5.35	5.78
3	7.5%	5.11	5.56	5.97
4	10%	5.19	5.64	6.07
5	12.5%	5.26	5.72	6.15
6	15%	5.13	5.58	6.02

Table 6 : Combined Split tensile strength Result of concrete by Partial replacement of 10% Zeolite Powder in Fine aggregate+ 12.5% Bamboo Chips in Coarse Aggregate

S.No	Combined replacements (%)	Split tensile Strength Results, N/mm ²		
		28 days	56 days	90 days
1	0	4.43	4.81	5.17
2	10%ZP+12.5%BC	5.69	6.19	6.65

5. CONCLUSIONS

1. The Normal Concrete of Compressive Strength results for 28 ,56 and 90 days is 49.26 N/mm² ,53.45 N/mm² and 57.51 N/mm².
2. The Normal Concrete of Split tensile Strength results is for 28 ,56 and 90 days is 4.43 N/mm² ,4.81 N/mm² and 5.17 N/mm².

3. At 10% partial replacement of Zeolite Powder with Fine Aggregate the Compressive Strength results for 28 ,56 and 90 days is 55.28 N/mm² ,60.12 N/mm² and 64.63 N/mm².
4. At 10% partial replacement of Zeolite Powder with Fine Aggregate the Split tensile Strength results for 28 ,56 and 90 days is 5.37 N/mm² ,5.83 N/mm² and 6.27 N/mm².
5. At 12.5% partial replacement of Bamboo Chips with Coarse Aggregate the Compressive Strength results for 28 ,56 and 90 days is 52.71 N/mm² ,57.32 N/mm² and 61.79 N/mm².
6. At 12.5% partial replacement of Bamboo Chips with Coarse Aggregate the Split tensile Strength results for 28 ,56 and 90 days is 5.26 N/mm² ,5.72 N/mm² and 6.15 N/mm².
7. By the combination of 10% partial replacement of Zeolite Powder with Fine Aggregate +12.5% partial replacement of Bamboo Chips with Coarse Aggregate in Concrete the Compressive Strength results for 28 ,56 and 90 days is 57.05 N/mm² ,62.15 N/mm² and 66.74 N/mm².
8. By the combination of 10% partial replacement of Zeolite Powder with Fine Aggregate +12.5% partial replacement of Bamboo Chips with Coarse Aggregate in Concrete the Split tensile Strength results for 28 ,56 and 90 days is 5.69 N/mm² ,6.19 N/mm² and 6.65 N/mm².

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