

## An Experimental Investigation on Concrete by Zeolite Powder as Partial Replacement of Fine Aggregate and Coarse Aggregate With Bamboo Chips

<sup>1</sup>DR.K.CHANDRAMOULI, <sup>2</sup>J.SREE NAGA CHAITANYA, <sup>3</sup>M.CHAITANYANAVA KUMAR AND <sup>4</sup>Y.PREM NIKHIL

<sup>1</sup>Professor & HOD, <sup>2&3</sup>Assistant Professor, <sup>4</sup>B.Tech Student,  
<sup>1,2,3,4</sup>Department of Civil Engineering, NRI Institute of Technology, Visadala (V), Medikonduru (M), Guntur, Andhra Pradesh, India.

### ABSTRACT

*The aim of this study is on the usage of zeolite powder as a partial cement substitute in concrete. The promotion of dietary supplement items as building materials is the main objective of this project. A naturally occurring material called zeolite powder is produced when volcanic ash and seawater react chemically. The cure period lasted for 7 and 28 days. But the compressive strength increased when we added additional zeolite powder to the cement mix. Zeolite, a naturally occurring pozzolanic mineral, is widely used in China.*

*The mechanical properties of concrete including bamboo chips as a potential source of aggregates were investigated in this work. In this experiment, compressive and tensile strengths are measured. A 0.5-cm-thick bamboo chip was cut into a 1-cm-wide by 1-cm-high piece, dried, wetted, and coated to lessen water absorption. With split tensile and compressive strength testing over 7 and 28 days, the coarse aggregates in the concrete specimen were swapped out with 0%, 5%, 7.5%, 10%, 12.5%, and 15% concrete.*

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

## 1. INTRODUCTION

The most popular building material worldwide, concrete is used for all kinds of structural development. Concrete will support post-tensioning and pre-tensioning techniques as it ages and becomes less dense. There are several ways to meet various wants, some of which might be stronger than usual. Concrete is made of water, cement, coarse aggregate, and fine aggregate. An exothermic process takes place when cement and water are combined, hardening each of the constituent parts of concrete. Zeolite is a mineral that naturally forms from sedimentary ash. When molten rock, volcanic ash, and seawater come together during an eruption, zeolite is produced. Zeolite is a crystalline solid made composed of the three elements silicon, aluminum, and oxygen. They have the capacity for

chemical sieving, ion exchange, filtration, and gas absorption. Zeolites are most frequently used in water softeners. Bamboo is a substitute that is simple to work with, bendable, and has a strong strength to weight ratio due to its natural characteristics. It is one of the close and easily accessible natural reserves that are expanding quickly. Bamboo has been employed in building since the dawn of time. Due to its rapid regeneration, bamboo has a significant economic potential, particularly in developing countries. Realizing that potential may need a thorough assessment of the state of bamboo housing today and its possibilities for the future.

## 2. OBJECTIVES

- a. To improve the fine aggregate by adding powdered zeolite.
- b. To maximize the potential of the coarse bamboo chip aggregate.
- c. To establish how likely it was to be used, tests on the strength and usability were analyzed.

## 3. MATERIALS

**a. Cement:** Concrete, a material used in building that binds and hardens to join other materials, often uses cement as a binder material.

**b. Fine Aggregate:** The most important component of natural sand or crushed stone-based concrete is fine aggregate. The hardened properties of the concrete are significantly influenced by the density and quality of the fine aggregate.

**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:** One of the most important materials in construction is water, which is needed for several tasks like making mortar, mixing cement, and curing work. The strength of the mortar and the cement concrete used in the construction project are both directly impacted by the quality of the water utilized.

**e. Zeolite powder:** Zeolite powder is another option for use as a partial substitute for cement in concrete. It has great pozzolanic reactivity and can efficiently absorb carbon dioxide from the atmosphere.

**f. Bamboo Chips:** Due to its unique rhizome-dependent structure, bamboo is known for having one of the plants with quick growth.

## 4. RESULTS AND DISCUSSIONS

**a. Compressive strength test:** A cube-shaped cast specimen of 150 mm by 150 mm by 150 mm is used for the compression strength test. The strength of the cast specimen was evaluated 7 and 28 days after it had finished curing in a water tank.

**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 <sup>2</sup>	
		7 days	28 days
1	0%	33.94	49.26
2	5%	35.17	52.65
3	10%	38.64	55.28
4	15%	36.81	53.19

**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 <sup>2</sup>	
		7 days	28 days
1	0%	33.94	49.26
2	5%	35.03	50.19
3	7.5%	35.71	51.59
4	10%	36.18	52.22
5	12.5%	36.58	52.71
6	15%	35.99	51.86

**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 <sup>2</sup>	
		7 days	28 days
1	0	33.94	49.26
2	10% ZP+12.5% BC	38.96	57.05

**b. Split tensile strength test:** At ages of 7 and 28 days, the split tensile strength of cylindrical specimens (150 mm in diameter x 300 mm in height) was assessed. A cylindrical sample that is horizontally positioned between the loading surfaces of a compression testing machine is given a load, and that 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 <sup>2</sup>	
		7 days	28 days
1	0%	3.04	4.43
2	5%	3.58	5.21
3	10%	3.75	5.37
4	15%	3.67	5.26

**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 <sup>2</sup>	
		7 days	28 days
1	0%	3.04	4.43
2	5%	3.41	4.95
3	7.5%	3.56	5.11
4	10%	3.68	5.19
5	12.5%	3.72	5.26
6	15%	3.53	5.13

**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 <sup>2</sup>	
		7 days	28 days
1	0	3.04	4.43
2	10%ZP+12.5% BC	3.99	5.69

## 5. CONCLUSIONS

1. The Normal Concrete of Compressive Strength result for 7 and 28 days is 33.94 N/mm<sup>2</sup> and 49.26 N/mm<sup>2</sup>.
2. The Normal Concrete of Split tensile Strength results is for 7 and 28 days is 3.99 N/mm<sup>2</sup> and 5.69 N/mm<sup>2</sup>.
3. At 10% partial replacement of Zeolite Powder with Fine Aggregate the Compressive Strength results for 7 and 28 days is 38.64 N/mm<sup>2</sup> and 55.28 N/mm<sup>2</sup>.
4. At 10% partial replacement of Zeolite Powder with Fine Aggregate the Split tensile Strength results for 7 and 28 days is 3.75 N/mm<sup>2</sup> and 5.37 N/mm<sup>2</sup>.
5. At 12.5% partial replacement of BambooChips with Coarse Aggregate the Compressive Strength results for 7 and 28 days is 36.58 N/mm<sup>2</sup> and 52.71 N/mm<sup>2</sup>.
6. At 12.5% partial replacement of BambooChips with Coarse Aggregate the Split tensile Strength results for 7 and 28 days is 3.72 N/mm<sup>2</sup> and 5.26 N/mm<sup>2</sup>.
7. By the combination of 10% partial replacement of Zeolite Powder with Fine Aggregate +12.5% partial replacement of BambooChips with Coarse Aggregate in Concrete the Compressive Strength results for 7 and 28 days is 38.96 N/mm<sup>2</sup> and 57.05N/mm<sup>2</sup>.
8. By the combination of 10% partial replacement of Zeolite Powder with Fine Aggregate +12.5% partial replacement of BambooChips with Coarse Aggregate in Concrete the Split tensile Strength results for 7 and 28 days is 3.99 N/mm<sup>2</sup> and 5.69 N/mm<sup>2</sup>.

## REFERENCES

- [1] Kadir Güçlüer, İsmail Demir. Utilization Of Zeolite And Blast Furnace Slag For The Production Of Autoclaved Aerated Concrete, Kadir Güçlüer Journal of Engineering Research and Application,8(11),2018,43-46.
- [2] Chalapati Harish, T.Naresh Kumar, V.Vishnuvardhan, Strength and Durability Properties by Replacement of Natural Zeolite and Fly ash in Ordinary Portland Cement, International Journal of Innovative Technology and Exploring Engineering (IJITEE)9(3),2020,1-7.
- [3] Şemsettin Kılınçarslan. The effect of zeolite amount on the physical and mechanical properties of concrete, International Journal of the Physical Sciences,6(13),2011,3041-3046.
- [4] Maran, Mani and Ravichandran, P.T. (2017). Experimental study on partial replacement of coarse aggregate by bamboo and fine aggregate by quarry dust in concrete. International Journal of Civil Engineering and Technology. 08.
- [5] J. Sree Naga Chaitanya, Dr.K. Chandramouli, Sk.Sahera, K. Divya, T. Anuradha, Experimental Investigation On Bamboo Fiber Reinforced Concrete By Using Zeolite Powder As Fine Aggregate And Ggbs As Cement Partial Replacement In Concrete, North Asian International Research Journal Of Sciences, Engineering & I.T., 9(5),(2023),40-47.
- [6] Ali Akbar Ramezani pour; Ali Kazemian; Morteza Sarvari; and Babak Ahmadi, Use of Natural Zeolite to Produce Self-Consolidating Concrete with Low Portland Cement Content and High Durability, journal of materials in civil engineering © asce / may 2013, 589-595.
- [7] J.Sree Naga Chaitanya, Dr. K.Chandramouli, Dr.N.Pannirselvam, J.Jayavani. Experimental Study on Partial Replacement of Fine Aggregate with Quarry Dust and Coarse Aggregate with Bamboo in Concrete, International Journal of Innovative Research In Technology, 8(4),(2021), 638-642.
- [8] Yadlapalli adilkshmi 1, J.Sreenagachaitanya 2, Experimental Investigation On Recron 3s Fiber Reinforced

Concrete With Partial Replacement Of Cement With Metakaolin And Fine Aggregate With Copper Slag, The International Journal Of Analytical And Experimental Modal Analysis Volume Xii, Issue Vii, July/2020 Issn No:0886-93672.

[9] Maran, Mani and Ravichandran, P.T. (2017). Experimental study on partial replacement of coarse aggregate by bamboo and fine aggregate by quarry dust in concrete. International Journal of Civil Engineering and Technology. 08.

[10] J. Sree Naga Chaitanya, Dr.K. Chandramouli, K. Divya ,Dr.D. Vijayakumar, K. Akarshitha. Mechanical Properties Of Bamboo Fiber Reinforced Concrete By Using Ggbs As Partial Replacement Cement And Zeolite Powder As Fine Aggregate Powder, North Asian International Research Journal Of Sciences, Engineering & I.T., 9(5),(2023),17-23.

[11] J.SreeNagaChaitanya,Dr.K.Chandramouli,N.Pannirselvam,M.Priyanka Experimental Investigation on Jute Fibre Concrete with Partial Replacement of Cement with Alccofine and Metakaolin Using M30 Grade of Concrete 8(4)(2021),591-594.

[12] TarasMarkiv, KhrystynaSabol, Malgorzata Franus, Wojciech Franus. Mechanical and durability properties of concretes incorporating natural zeolite. Archives of civil and mechanical engineering. 2016, 16, pp 554-562.