North Asian International Research Journal of Sciences, Engineering & I.T.

IRJIF. I.F. : 3.821

ISSN: 2454-7514 Vol. 8, Issue-8, August-2022

Index Copernicus Value: 52.88 Indian Citation Index Thomson Reuters ID: S-8304-2016

A Peer Reviewed Refereed International Journal

STRENGTH STUDIES ON RECRON 3S FIBER CONCRETE WITH BAMBOO CHIPS AND OYSTER SHELL POWDER

1DR.K.CHANDRAMOULI, [2] J.SREE NAGA CHAITANYA, [3]K.DIVYA, [4]SYED YASIN

[1]Professor & HOD, [2,3] Assistant Professor, [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:jarugumillichaitanya1989@gmail.com, koduru_mouli@yahoo.com

ABSTRACT

Concrete is the most extensively used construction material worldwide, yet its production requires large quantities of cement and natural aggregates, resulting in significant environmental impacts.To mitigate these concerns, sustainable alternatives are being explored.This study incorporates Recron 3S fibers into concrete to enhance crack resistance and overall toughness.Oyster shell powder, a calcium-rich material, is used as a partial replacement for cement, thereby reducing cement consumption and lowering CO_2 emissions. Additionally, bamboo chips, a renewable natural resource, serve as a partial substitute for coarse aggregates, encouraging the eco-friendly utilization of resources.The experimental program consists of preparing concrete mixes with these alternative materials and casting standard cube and cylinder specimens.After curing under standard conditions, the specimens are tested for mechanical performance.Compressive strength is evaluated at 28, 56, and 90 days to determine load-bearing capacity, while split tensile strength is assessed at the same curing intervals.The cementitious properties of oyster shell powder are analyzed for their contribution to strength development, and bamboo chips are examined for their suitability in partially replacing coarse aggregates without compromising durability.The research demonstrates the potential of integrating industrial and natural waste products into concrete, fostering cost-effective, sustainable, and environmentally responsible construction practices.Overall, the study provides useful insights into the application of innovative materials for producing durable and eco-friendly concrete.

KEYWORDS:Bamboo chips,Recron 3s,Oystershell powder,eco-friendly ,sustainability,Compressive strength and Split tensile

1. INTRODUCTION

Concrete is the most widely used material in construction, consisting of cement, fine aggregates (sand), coarse aggregates (gravel or crushed stone), and water mixed in proper proportions. Through the process of hydration, these ingredients bind together and gradually harden. Concrete is highly valued for its compressive strength, durability, and versatility, as it can be molded into various shapes before setting.

Oyster shell powder, derived from discarded oyster shells rich in calcium carbonate, provides a sustainable alternative to conventional cement materials. The seafood industry generates large amounts of oyster shell waste, creating environmental and disposal challenges. Converting this waste into powder not only offers an eco-friendly recycling option but also reduces the demand for cement and associated CO_2 emissions. With cementitious properties similar to limestone, oyster shell powder can improve durability and long-term strength while lowering dependence on non-renewable raw materials.

Bamboo chips, obtained by cutting bamboo into small pieces, serve as another renewable and sustainable material.Lightweight, strong, and widely available, bamboo chips can be used to partially replace coarse aggregates in concrete.Their tensile strength and toughness can enhance concrete's mechanical performance while reducing the exploitation of natural stone resources.Thus, bamboo chips contribute to eco-friendly and resource-efficient construction.

3S fibers, synthetic polyester fibers designed for concrete and mortar, further enhance performance when added in small quantities.Acting as secondary reinforcement, they control shrinkage cracks, bridge microcracks, and prevent their propagation.This results in improved ductility, toughness, impact resistance, and durability.Additionally, these fibers reduce early-age cracking and increase resistance to abrasion and water seepage, thereby extending the service life of concrete structures.Recron 3S fibers thus provide a cost-effective solution for producing stronger, more durable, and crack-resistant concrete.

2. OBJECTIVES

1. To examine the role of Recron 3S fibers in concrete as an additive for enhancing crack resistance, ductility, and long-term durability.

2. To assess the effect of oyster shell powder, used as a partial replacement for cement, on the compressive and tensile strength characteristics of concrete.

3. To evaluate the suitability of bamboo chips as a partial substitute for coarse aggregates and determine their influence on the strength performance and sustainability of concrete.

3. MATERIALS

3.1Cement: Cement is a widely used binding material in construction, produced mainly from limestone and clay. When mixed with water, it undergoes hydration, hardening to bind the aggregates together. It imparts strength, durability, and cohesion to concrete.

3.2 Fine Aggregate: Fine aggregate consists of natural sand or crushed stone that passes through a 4.75 mm sieve. It fills the voids between coarse aggregates, enhances workability, and contributes to the strength and smooth finish of concrete.

3.3 Coarse Aggregate: Coarse aggregate is composed of gravel or crushed stone retained on a 4.75 mm sieve. It forms the skeleton of the concrete mix, providing bulk, strength, and resistance to shrinkage while improving load-bearing capacity.

3.4 Water: Water is an essential component of concrete, necessary for the hydration of cement. It ensures workability and proper setting of the mix. Both the quality and quantity of water directly influence the strength and

durability of concrete.

3.5 Oyster Shell Powder : Oyster shell powder is produced by grinding discarded oyster shells, a calcium carbonate–rich waste material. Due to its cementitious properties, it can serve as a partial replacement for cement, reducing environmental impact and cement consumption.

3.6 Bamboo Chips : Bamboo chips are small, processed pieces of bamboo used as a renewable alternative to coarse aggregates. Lightweight and strong, they help conserve natural stone resources while contributing to sustainable concrete production.

3.7 Recron 3S Fibers : Recron 3S fibers are synthetic polyester fibers added in small amounts to concrete. They act as secondary reinforcement by controlling plastic shrinkage cracks, improving toughness, and enhancing durability, ductility, impact resistance, and water seepage resistance.

4. EXPERIMENTAL RESULTS

4.1 Compressive strength:-In this test, concrete cubes of standard size (usually 150 mm × 150 mm × 150 mm) are cast and cured. After 28, 56 and 90 days, the cubes are placed in a compression testing machine. Load is applied gradually until failure, and the maximum load is used to calculate compressive strength.

Table 1: Compressive strength results of concrete oyster shell powder as partial replacement of cement.

Sl.no	% of oyster shell powder	Compressive Strength Results, N/mm^2		
		28 days	56 days	90 days
1	0%	39.34	42.49	45.63
2	5%	40.31	43.54	46.75
3	10%	41.83	45.17	48.52
4	15%	41.62	44.93	48.27

Table 2: Compressive strength results of concrete bamboo chips as partial replacement of coarse aggregate.

Sl.no	% of bamboo chips	Compressive Strength Results, N/mm^2		
		28 days	56 days	90 days
1	0%	39.34	42.49	45.63
2	6%	40.87	44.13	47.41
3	12%	41.72	45.05	48.39
4	18%	41.09	44.37	47.68

Table 3: Compressive strength results of concrete by addition of recron 3s fiber .

Sl.no	% of recron 3s fibers	Compressive Strength Results, N/mm^2		
		28 days	56 days	90 days
1	0%	39.34	42.49	45.63
2	0.25%	40.81	44.07	47.38
3	0.5%	41.62	44.95	48.27
4	0.75%	42.46	45.84	49.56
5	1%	41.12	44.47	47.69

Table 4: Compressive strength results of combined replacement of 10%OSP+12%BC+0.75%3SRF in concrete.

Sl.no	10%OSP+12%BC+0.75%3SRF	Compressive Strength Results, N/mm^2		
		28 days	56 days	90 days
1	0%	39.34	42.49	45.63
2	10%OSP+12%BC+0.75%3SRF	44.89	48.51	52.07

4.2 Split tensile strength:- **Split tensile strength** is an indirect method to evaluate the tensile resistance of concrete, since concrete is inherently weak in direct tension. In this test, a cylindrical specimen is placed horizontally and a compressive load is applied along its diameter. This loading induces tensile stresses inside the cylinder, causing it to split along the loaded diameter. The test is carried out at 28, 56 and 90 days of curing to study the cracking behavior and tensile strength development of concrete.

Table 5: Split tensile strength results of concrete oyster shell powder as partial replacement of cement.

Sl.no	% of oyster shell powder	Split tensileStrength Results, N/mm^2		
		28 days	56 days	90 days
1	0%	3.86	4.16	4.47
2	5%	3.99	4.31	4.62
3	10%	4.14	4.56	4.84
4	15%	4.09	4.42	4.75

Table 6: Split tensile strength results of concrete bamboo chips as partial replacement of coarse aggregate.

Sl.no	% of bamboo chips	Split tensileStrength Results, N/mm^2		
		28 days	56 days	90 days
1	0%	3.86	4.16	4.47
2	6%	4.04	4.38	4.69
3	12%	4.11	4.43	4.76
4	18%	4.06	4.29	4.54

Table 7: Compressive Split tensile strength results of concrete by addition of recron 3s fiber .

Sl.no	% of recron 3s fibers	Split tensile Strength Results, N/mm^2		
		28 days	56 days	90 days
1	0%	3.86	4.16	4.47
2	0.25%	4.01	4.33	4.65
3	0.5%	4.13	4.42	4.79
4	0.75%	4.19	4.57	4.86
5	1%	4.08	4.41	472

Table 8: Split tensile strength results of combined replacement of 10%OSP+12%BC+0.75%3SRF in concrete.

Sl.no	10%OSP+12%BC+0.75%3SRF	Split tensileStrength Results, N/mm^2		
		28 days	56 days	90 days
1	0%	3.86	4.16	4.47
2	10%OSP+12%BC+0.75%3SRF	4.52	4.85	5.24

5. CONCLUSION

1. The normal concrete without any replacement achieved a compressive strength of **39.34, 42.49 and 45.63 N/mm² at 28, 56 and 90 days.**
2. The use of **oyster shell powder (OSP) as a partial replacement of cement** showed the optimum strength at **10% replacement**, reaching**41.83, 45.17 and 48.52 N/mm² at 28, 56 and 90 days.**
3. The use of **bamboo chips (BC) as a partial replacement of coarse aggregate** yielded the best results at **12% replacement,** with strengths of**41.72, 45.05 and 48.39 N/mm² at 28, 56 and 90 days**.
4. The addition of **Recron 3S fibers** showed maximum improvement at **0.75% addition**, achieving **42.46, 45.84 and 49.56 N/mm² at 28, 56 and 90 days.**

5. The **combined replacement of 10% OSP + 12% BC + 0.75% Recron 3S fibers** gave the highest strength, reaching **44.89, 48.51 and 52.07 N/mm² at 28, 56 and 90 days**, which is significantly higher than normal concrete.
6. The normal concrete without any replacement achieved a split tensile strength of **3.86, 4.16 and 4.47 N/mm² at 28, 56 and 90 days.**
7. The use of **oyster shell powder (OSP) as a partial replacement of cement** showed the optimum strength at **10% replacement,** reaching**4.14, 4.56 and 4.84 N/mm² at 28, 56 and 90 days.**
8. The use of **bamboo chips (BC) as a partial replacement of coarse aggregate** yielded the best results at **12% replacement,** with strengths of**4.11, 4.43 and 4.76 N/mm² at 28, 56 and 90 days.**
9. The addition of **Recron 3S fibers** showed maximum improvement at **0.75% addition,** achieving **4.19, 4.57 and 4.86 N/mm² at 28, 56 and 90 days.**
10. The **combined replacement of 10% OSP + 12% BC + 0.75% Recron 3S fibers** gave the highest split tensile strength, reaching **4.52, 4.85 and 5.24 N/mm²at 28, 56 and 90 days,** which is significantly higher than normal concrete.

6. REFERENCES

1. Balamurugan, G., & Saravanan, J. (2020). Experimental investigation on concrete with Recron 3S fiber. International Journal of Recent Technology and Engineering, *8(5)*, 2277–3878.
2. K.Chandramouli, N.Pannirselvam, J. Sree Naga Catania, G. Hymavathi. Experimentalinvestigation on AR glass fiber reinforced concrete with silica fume,6th International Conference on Recent Advances in Material Chemistry,68, 2022, Pages 136-138.
3. Choi, S., Lee, K., & Moon, J. (2021). Oyster shell waste as a sustainable material for concrete: A review. *Heliyon*, *7*(6), e07267. https://doi.org/10.1016/j.heliyon.2021.e07267
4. DR.K.CHANDRAMOULI, J.SREE NAGA CHAITANYA, .M.CHAITANYANAVA KUMAR AND Y.PREM NIKHIL.An Experimental Investigation on Concrete by Zeolite Powder as Partial Replacement of Fine Aggregate and Coarse Aggregate With Bamboo Chips.North Asian International Research Journal of Sciences, Engineering & I.T,9(10),October-2023.
5. **R Jagadheeswari.** Experimental Study to Reduce Cracks and Enhance Strength & Durability by Appending Recron 3S Fibre. *Elsevier Article* (2022).
6. J. SREE NAGA CHAITANYA, DR.K. CHANDRAMOULI, SK.SAHERA,DR.D.VIJAYAKUMAR,5M. SIREESHA.STRENGTH STUDIES ON GRAPHENE OXIDEAND METAKAOLIN AS PARTIALREPLACEMENT OF CEMENT ANDQUARRY DUST AS PARTIAL REPALCEMENT OFFINEAGGREGATE INCONCRETE,North Asian International Research Journal of Sciences, Engineering & I.T,9(5),May-2023.
7. Sharma, R., & Singh, A. (2021). Bamboo as sustainable construction material*:* A review on its applications in concrete. *Materials Today: Proceedings, 46, 5537*–5543. https://doi.org/10.1016/j.matpr.2021.04.171
8. K.Chandramouli , N.Pannirselvam ,J.Sree Naga Chaitanya, andG.Hymavathi.Experimental Investigation on Self Compacting Concrete with SilicaFume,International Conference on Smart Materials and Structures(ICSMS),2810(1),June 22 2023.

9. Thirumurugan, S., & Subramanian, R. (2019). *Strength behaviour of concrete using bamboo chips as partial replacement for coarse aggregates*. International Journal of Civil Engineering and Technology, 10(2), 223–230.
10. Jayasudha, K., & Dhanalakshmi, G. (2020). *Experimental investigation on partial replacement of cement with oyster shell powder in concrete*. International Journal of Engineering Research & Technology, 9(4), 2278–0181.
11. M Prabu, I Mohammed Rafi, M Sathees Kumar. Experimental Investigation on Concrete Using Recron Fibre as Reinforcement. *International Journal of Innovative Research in Science, Engineering and Technology* (IJI RSET), Vol. 8 Issue 3, March 2019.
12. Gopalakrishnan, S., & Karthikeyan, M. (2019). *Study on the mechanical properties of concrete using Recron 3S fiber*. International Journal of Innovative Technology and Exploring Engineering, 8(8S).
13. J. Sree Naga Chaitanya; Dr. K. Chandramouli; Dr. D. Vijaya Kumar; N. Varalakshmi, Investigation on Concrete by Using Carbon Fibers and Partial Replacement of Sand with Copperslag and Cement with Metakaolin, *Gis Science Journal*, Volume 9, Issue 7, 2022, **Pages**: 1308–1310.
14. Li, J., Xu, Q., & Wang, Y. (2020). Effect of recycled oyster shell powder on the hydration and strength of magnesium phosphate cement. *Advances in Cement Research, 32*(11), 505–514. https://doi.org/10.1680/jadcr.22.00103