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Experimental Study on Strength Behaviour of Cellulose Fibre Reinforced Concrete

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Abstract: This report explains how the structure of cellulose has been studied over time. Early models based only on diffractometry could not explain all results, so newer methods like Raman spectroscopy and carbon-13 NMR were used to develop more accurate models. These improved models help scientists better understand how cellulose structure changes with its source and processing, which affects its material properties. At the same time, there is a growing need for sustainable materials in industries like construction to protect the environment and meet sustainability goals. While synthetic fibres such as CFRP and GFRP are widely used, their environmental impact has led to increased interest in natural fibres. These natural fibres can improve the strength and flexibility of building materials while being more eco-friendly.

I. Introduction

Cellulose fibre concrete is an innovative and sustainable construction material developed by incorporating cellulose fibre into conventional concrete. These fibres are generally derived from natural sources such as wood pulp, paper waste, or agricultural residues, making them environmentally friendly and renewable. The addition of cellulose fibre to concrete cubes aims to enhance certain mechanical and durability properties, particularly crack resistance, toughness, and shrinkage control.

Concrete cubes containing cellulose fibres are commonly cast and tested to evaluate compressive strength, workability, and overall performance compared to conventional concrete. The fibres act as micro-reinforcement within the cement matrix, helping to distribute stress more evenly and reducing the information of micro cracks during curing and loading. Due to their low cost, biodegradability, and ease of availability, cellulose fibres offer a promising alternative to synthetic fibres in sustainable construction practise.

Concrete is one of the most common construction materials, but it naturally has low tensile strength and limited toughness because of internal flaws. Its properties can be improved by incorporating small amounts of fibres and partially replacing cement with pozzolanic materials like fly ash, slag, rice husk ash, metakaolin, or silica fume. Using fibres such as steel, glass, natural cellulose, carbon, nylon, or polypropylene along with these additives helps increase the concrete’s strength, durability, and flexibility.

II.LITERATURE REVIEW

Bentur and Mindess (2007) studied fibre-reinforced cementitious composites and showed that adding short fibres improves crack control, toughness, ductility, and post-cracking behavior. They highlighted the potential of natural fibres, such as cellulose, as sustainable and low-cost reinforcement, though challenges like durability and fibre–matrix compatibility remain.

Savastano Jr. et al. (2009) focused specifically on cellulose fibres in cement-based materials. Their study found that chemically treated cellulose fibres enhance toughness, flexural strength, and crack resistance, making them suitable for non-structural elements. Proper treatment and mix design were emphasized as essential to prevent fibre degradation in alkaline cement environments.

Overall, these studies show that cellulose fibres can improve the mechanical performance of cementitious composites while offering environmental benefits. They also suggest that combining fibres with pozzolanic materials, such as fly ash or silica fume, can further enhance concrete strength, durability, and flexibility. This makes cellulose fibre-reinforced concrete a promising sustainable material for modern construction

3.Methodology

3.1 Selection of Materials

Ordinary Portland cement, fine aggregate, coarse aggregate, potable water, and cellulose fibre were used for the preparation of concrete cubes. The concrete mix was designed for M20 grade concrete.

3.2 Mix Design

Concrete mix proportion adopted was 1:1.55:2.67 with a water–cement ratio of 0.50 cellulose fibre was added as a percentage of cement weight. Three different fibre percentages were used, namely 0.25 percent, 0.50 percent, and 0.75 percent. One normal concrete cube without fibre was also prepared for comparison.

3.3 Preparation of Concrete Cubes

- The materials were weighed accurately as per the mix design.
- Cement, fine aggregate, and coarse aggregate were first mixed in dry condition until a uniform colour was obtained.
- Required quantity of cellulose fibre was added to the dry mix and mixed thoroughly to ensure uniform distribution.
- Water was then added gradually, and the concrete was mixed until a workable and homogeneous mix was obtained.
- The prepared concrete was placed into cube moulds of size 150 mm x 150 mm x 150 mm in three layers.
- Each layer was compacted properly using a tamping rod to remove air voids.
- The top surface was finished smoothly.

A total of four cubes were cast:

- One normal concrete cube (0 % fibre)
- Three sets of cellulose fibre reinforced concrete cubes with each set of 0.25%, 0.50%, and 0.75% fibre content.

3.4 Curing of Concrete Cubes

- After casting, the cubes were kept undisturbed for 24 hours.
- The cubes were then demoulded carefully.
- All the cubes were immersed in clean water for curing.
- Curing was carried out for 28 days to ensure proper hydration and strength development.

3.5 Compression Testing Machine – Mechanism

The Compression Testing Machine works on the principle of applying gradually increasing compressive load on the concrete specimen until failure occurs. The load is applied uniformly through steel plates. As the load increases, the concrete cube resists the compressive force. When the applied load exceeds the compressive strength of the concrete, the cube fails. The maximum load at failure is recorded, and compressive strength is calculated

3.6 Procedure for Compressive Strength Test

After 28 days of curing, the cubes were dried and their dimensions measured. Each cube was placed in the compression testing machine, loaded gradually until failure, and the compressive strength was calculated.

Compressive strength = Load at failure / Area of cube

The same procedure was followed for all cubes, including the normal cube and fibre-added cubes.

Total Nine cubes were prepared with change in Percentage of cellulose fibre reinforced concrete.

Cube no	Fibre %	Cement (kg)	Fine Aggregate (kg)	Coarse Aggregate (kg)	Water (ml)	Cellulose Fibre (g)
1	0.25	1.35	2.025	4.05	675	19.68
2	0.5	1.35	2.025	4.05	675	39.37
3	0.75	1.35	2.025	4.05	675	59.06

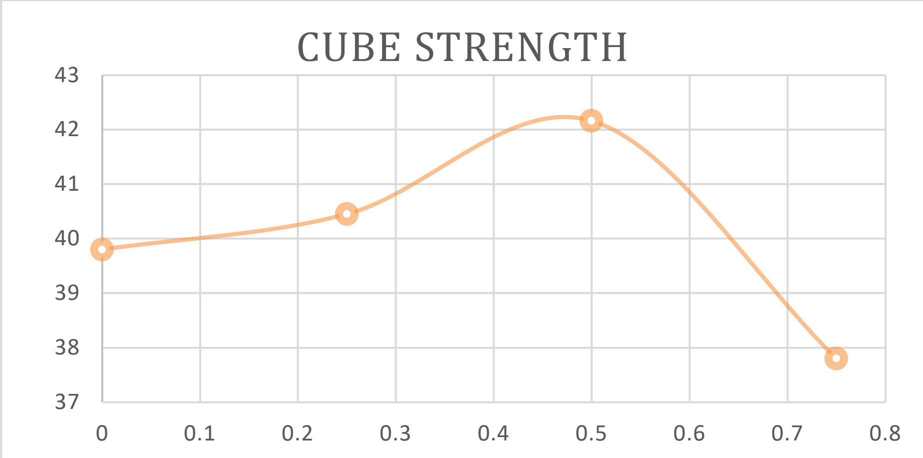
IV. RESULTS AND DISCUSSION

RESULT

SPECIMEN NO	Number	WEIGHT (KG)	MAX LOAD (KN)	COMPRESSIVE STRENGTH (N/mm^2)	AVGE.COMPRESSIVE STRENGTH (N/mm^2)
Normal cube	1	8.700	902	40.08	39.82
	2	8.650	910.6	40.47	
	3	8.680	874.2	38.85	
Cube 1 (0.25%)	1	8.365	912	40.53	40.45
	2	8.450	918.5	40.82	
	3	8.520	900.1	40	
Cube 2 (0.5%)	1	8.495	954.7	42.43	42.16
	2	8.230	968.4	43.04	
	3	8.410	953.2	42.36	
Cube 3 (0.75%)	1	8.510	851.5	37.84	37.80
	2	8.620	845	37.55	
	3	8.495	855	38	

Graph description : Effect of cellulose fibre of compressive strength is Tested for 28days of curing..

- The graph shows a significant increase in compressive strength with the addition of cellulose fibre compared to normal concrete.
- Maximum compressive strength is observed at 0.5% fibre content.
- This indicates that optimum fibre dosage improves strength, while careful control of fibre percentage is necessary.



x-
percentage of cellulose fibre

y-compressive strength(N/mm^2)

V.Conclusion

- Cellulose fibres improve the strength, durability, and sustainability of concrete, making it suitable for modern construction.
- The compressive strength increased moderately by about 5.85% when 5% cellulose fibre was added, improving from 39.82 to 42.16N/mm2.
- Fibre inclusion increases resistance to first cracking and enhances the energy absorption capacity of concrete.

REFERENCES

1. Arnon Bentur, A., & Sidney Mindess, S. (2007). *Fibre Reinforced Cementitious Composites*. CRC Press, Boca Raton.
2. Holmer Savastano, H., Peter G. Warden, P. G., & R. S. P. Coutts, R. S. P. (2005). Microstructure and mechanical properties of cellulose fibre–cement composites. *Cement and Concrete Composites*, 27(5), 583–592.
3. Montserrat Ardanuy, M., Jordi Claramunt, J., & Romildo Dias Toledo Filho, R. D. (2015). Cellulosic fibre reinforced cement-based composites: A review. *Construction and Building Materials*, 79, 115–128.
4. Fernando Pacheco-Torgal, F., & Said Jalali, S. (2011). Cementitious building materials reinforced with vegetable fibres. *Construction and Building Materials*, 25(2), 575–581.
5. Romildo Dias Toledo Filho, R. D., Karen Scrivener, K., G. L. England, G. L., & Khosrow Ghavami, K. (2000). Durability of alkali-sensitive sisal and coconut fibres in cement mortar composites. *Cement and Concrete Composites*, 22(2), 127–143.