Uluslararası İleri Doğa Bilimleri ve Mühendislik Araştırmaları Dergisi
Sayı 9, S. 248-252, 3, 2025

Araştırma Makalesi

IJANSER
https://as-proceeding.com/index.php/ijanser
ISSN:2980-0811

International Journal of Advanced Natural Sciences and Engineering Researches
Volume 9, pp. 248-252, 3, 2025

Research Article

Performance of Fiber Reinforced Concrete with Dispersing Agent

Tamoor Danish[*], Faisal Shabbir [2]

[1]*Department of Civil Engineering, University of Engineering and Technology Taxila, Pakistan*
[2]*Department of Civil Engineering, University of Engineering and Technology Taxila, Pakistan*

[*]*(tamoordanish05@gmail.com)*

(Received: 06 March 2025, Accepted: 07 March 2025)

(4th International Conference on Recent Academic Studies ICRAS 2025, March 04-05, 2025)

ATIF/REFERENCE: Danish, t. & Shabbir, F. (2025). Performance of Fiber Reinforced Concrete with Dispersing Agent. *International Journal of Advanced Natural Sciences and Engineering Researches*, 9(3), 248-252.

Abstract: This study investigates the effect of dispersion of fiber in carbon fiber reinforced concrete (CFRC) and coconut fiber reinforced concrete (CoFRC) by using sodium hydroxide (NaOH) as a dispersing agent. The clustering and entanglement of the fiber in concrete decreases the uniformity of fiber which reduces the strength of concrete A 0.5g/mL concentration of NaOH was used to enhance the dispersion of fiber in concrete. The content of carbon fiber and coconut fiber was used 2% by volume of concrete and a comparison is made between the effectiveness of NaOH on dispersion of both fibers. The effect of dispersion was assessed by finding the mechanical properties of concrete. The concrete cylinders were cast to find the compressive strength, splitting tensile strength and water absorption of concrete. The results show that the compressive strength of CFRC with dispersed fiber is increased by 4.84% as compared to untreated carbon fiber and compressive strength of CoFRC with dispersed coconut fiber is increased by 3.05%. The tensile splitting strength of CFRC with dispersed fiber increased by 9.76% and the tensile splitting strength of CoFRC with dispersed fiber increased by 6.67% as compared to untreated fiber. The use of dispersion agent increases the water absorption of concrete.

Keywords – Fiber Reinforced Concrete, Dispersing Agent, Tensile Strength, Compressive Strength, Coconut Fiber Reinforced Concrete.

I. INTRODUCTION

The most widely used materials in construction all over the world is concrete . High compressive strength, better durability and resistance to erosion makes concrete ideal for use. Constituents of concrete are easily available and cheaper as compared to other materials. However, the tensile strength of concrete is very low compared to its compressive strength [1]. The tensile strength of concrete increases by using different types of fiber as a reinforcement in concrete includes steel fiber, carbon fiber, glass fiber, coconut fiber etc. These fibers not only increase the tensile strength of concrete but also increase the compressive strength and durability of concrete. [2, 3, 4]. The introduction of these fibers decreases the workability of concrete because the fiber hinders the flow of concrete. The workability of concrete is increased by incorporation of plasticizers in concrete.[5]. The increase in the tensile strength of concrete by the addition of fiber is limited to some percentages of fiber i.e. for carbon fiber maximum compressive strength is attained at 1% of carbon fiber by volume of concrete. [6]. In the case of coconut fiber maximum compressive is gained at 3% of

coconut fiber by volume of concrete.[7]. At higher percentage of fiber, the permeability of concrete increases which reduces the mechanical strength of concrete. [8, 9]. Higher percentage of fibers causes clustering of fiber which reduces the distribution of fiber in concrete. Dispersing agents can be used to increase the dispersion of fiber in concrete which enhances the strength of concrete. [10,11]

II. MATERIALS AND METHOD.

A. Materials Used

Ordinary Portland Cement (OPC), Type 1 was used for all the mixes which is available locally from Best Way cement factory. The chemical composition of the cement is given in table 1.

Table 1: Cement Composition

Compound	Quantity in percentage
SiO_2.	21
Al_2O_3	5.04
Fe_2O_3	3.24
CaO	61.70
MgO	2.56
SO_3	1.51
Misc.	4.95

Carbon fiber is used as a synthetic fiber while coconut fiber is used as a natural fiber in concrete. The length of carbon fiber and coconut fiber used is 18mm and 40mm respectively. Sodium hydroxide is used as a dispersing agent to disperse the fiber.

B. Mix Design and Casting

Mix proportion 1:1.5:3 is used for casting the cylinders. The detail of casting of cylinders is given in table 2.

Table 2: Details of specimens

Mix ID	CF%	Co.F%
CS	0	0
C2	2	0
Co2	0	2
C2+DA	2	0
C02+DA	0	2

Total 37 cylinders were cast for determining the compressive strength, tensile strength and water absorption of concrete.

Fig 1: Casting of samples

The fiber is soaked in 0.5g/mL of NaOH solution for 2 hours and then added in the mix

III. RESULTS

A. Compressive Strength

Fig 2 shows the compressive strength of concrete samples. The increase in compressive strength of concrete with addition of 2% carbon fiber is 3.33% while for 2% coconut fiber increase in strength of concrete is 9.17% as compared to control specimen. The increase in case of dispersing agent is 8.33% and 12.5% for carbon CFRC and CoFRC respectively.

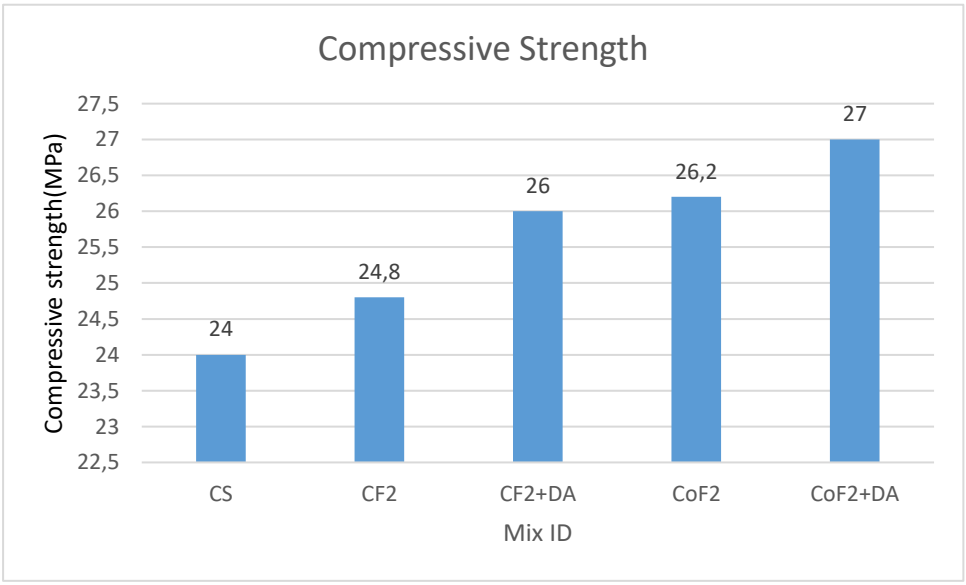

Fig 2: Compressive strength of different mixes

B. Tensile Splitting Strength

The figure below shows the splitting tensile strength of the mixes. It shows that addition of 2% carbon fiber enhances splitting tensile strength of CFRC 95.24% while 2% of coconut fiber improves the splitting tensile strength 42.86%.

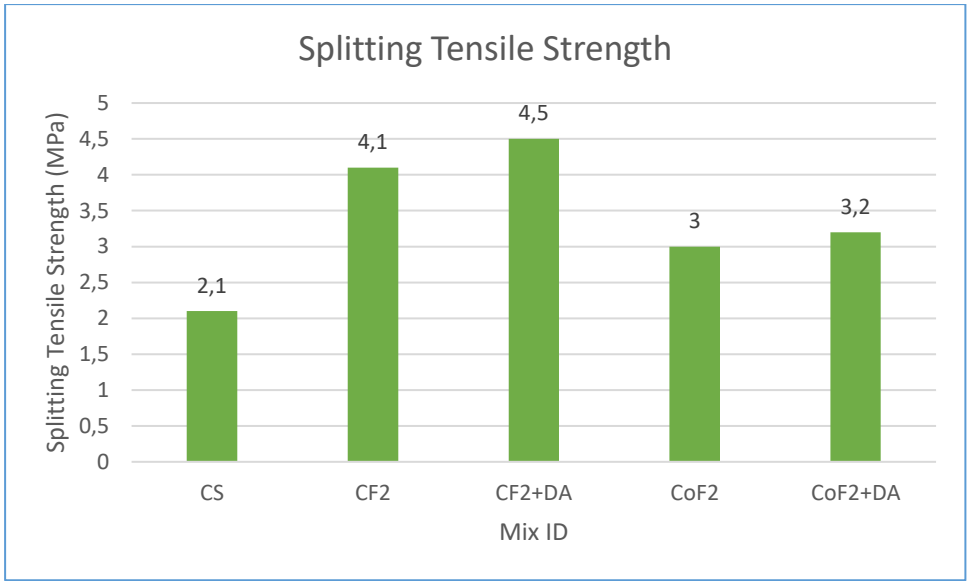

Fig 3: Splitting Tensile Strength of mixes

C. Water Absorption

Fig 4 shows the water absorption of all 5 mixes. The absorption of water by addition of 2% carbon fiber reduces from 3.2% to 2.2%. The absorption of water in case of dispersing agent 2.5% slightly higher than untreated CFRC. In case of 2% coconut fiber the absorption of water increases to 7.2% and for dispersing agent it is 7.6%.

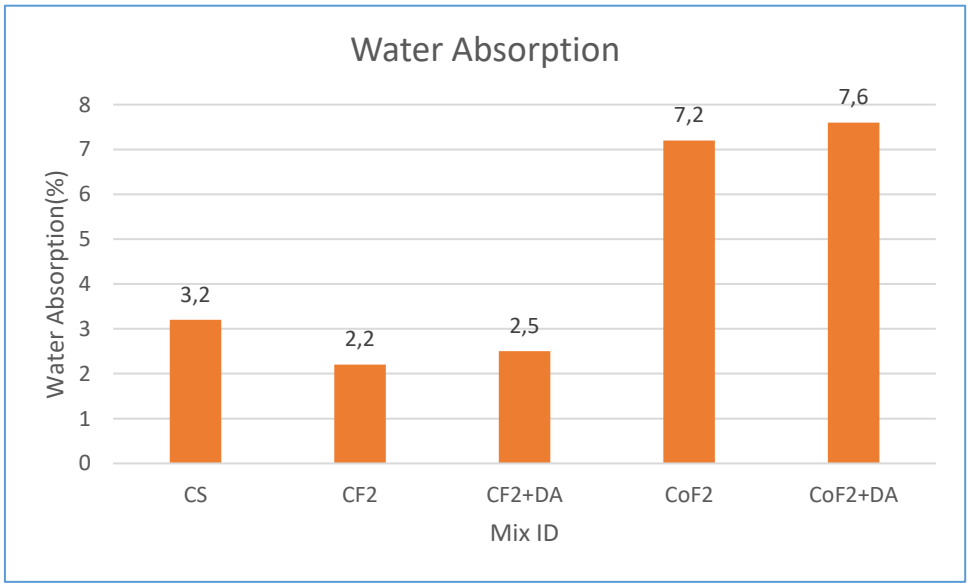

Fig 4: Water absorption of mixes

IV. DISCUSSION

The result for compressive strength shows that the strength of CoFRC is more than CFRC at 2% dosage of fiber. The surface of the carbon is hydrophobic which decreases the uniformity of fiber in concrete mix leading to the reduction of strength. However, when dispersing agent is used its effect is more dominant on carbon fiber. The dispersing agent increases the wettability of carbon fiber and weakens the Van Der Waal forces which helps carbon fiber to disperse evenly in the mix.

The absorption of water in CFRC as compared to CoFRC due to hydrophobic nature of carbon fiber and hydrophilic nature of coconut fiber. The carbon fiber does not absorb water, but coconut fiber absorbs water which increases the absorption of water. The dispersing agent increases the absorption of water for both type of fiber.

V. CONCLUSION

- The dispersing agent enhances the compressive strength of concrete due to uniform distribution of the fiber in concrete as compared to the fiber without dispersing agent.
- The dispersing agent affects the mechanical properties of CFRC more as compared to CoFRC.
- The dispersion of fiber using NaOH as dispersing agent increases the wettability of fiber which increases the absorption of water
- NaOH is an effective dispersing agent for both fiber types, enhancing concrete performance

REFERENCES

[1] Cristián Gaedicke , Anthony Torres , Khanh C.T. Huynh, Armando Marines "A method to correlate splitting tensile strength and compressive strength of pervious concrete cylinders and cores."
[2] Pikus, G.A. Steel fiber concrete mixture work ability. Procedia Eng. 2016, 150, 2119–2123.
[3] Ali, M.; Li, X.; Chouw, N. Experimental investigations on bond strength between coconut fibre and concrete. Mater. Des. 2013, 44, 596–605M.
[4] M. Yakhlaf, M. Safiuddin, K.A. Soudki, Properties of freshly mixed carbon fibre reinforced self-consolidating concrete, Constr. Build. Mater. 46 (2013) 224–231.
[5]] N. Baldino, D. Gabriele, F.R. Lupi, L. Seta, R. Zinno, Rheological behaviour of fresh cement pastes: influence of synthetic zeolites, limestone and silica fume, Cement Concr. Res. 63 (2014) 38–45
[6] S.Y. Ghanem, J. Bowling, Mechanical properties of carbon-fiber-reinforced concrete, Adv. Civ. Eng. Mater. 8 (2019)
[7] Anandh Sekar and Gunasekaran Kandasamy "Optimization of Coconut Fiber in Coconut Shell Concrete and Its Mechanical and Bond Properties." Sept.2018
[8] Yerramala, A.; Ramachandrudu, C. Properties of concrete with coconut shells as aggregate replacement. Int. J. Eng. Invent. 2012, 1, 21–31
[9] V. Afroughsabet, T. Ozbakkaloglu, Mechanical and durability properties of high- strength concrete containing steel and polypropylene fibers, Constr. Build. Mater. 94 (2015) 73–82
[10] Wang, C.; Li, K.Z.; Li, H.J.; Jiao, G.S.; Lu, J.; Hou, D.S. Effect of carbon fiber dispersion on the mechanical properties of carbon f iber-reinforced cement-based composites. Mater. Sci. Eng. A 2008, 487, 52–57
[11] Cao, J.; Chung, D.D.L. Carbon fiber reinforced cement mortar improved by using acrylic dispersion as an admixture. Cem. Concr. Res. 2001, 31, 1633–1637
[12] Gunasekaran, K.; Pennarasi, G.; Soumya, S.; Richards, N.J. Study for the relevance of coconut shell aggregate concrete flooring tiles. Int. J. Civil Eng. Technol. 2017, 8, 370–379.
[13] Lee, J.H. Influence of concrete strength combined with fiber content in the residual flexural strengths of fiber reinforced concrete. Compos. Struct. 2017, 168, 216–225.
[14] Daskiran,M.M.;Daskiran, E.G.; Gencoglu, M.Mechanicalanddurabilityperformanceoftextile reinforced cementitious composite panels. Constr. Build. Mater. 2020, 264, 120224
[15] DeMunck,M.;ElKadi,M.;Tsangouri,E.;Vervloet,J.; Verbruggen,S.; Wastiels, J.; Tysmans, T.; Remy, O.Influenceofenvironmental loading on the tensile and cracking behaviour of textile reinforced cementitious composites. Constr. Build. Mater. 2018, 181, 325–334.