Effect of Seawater on Mechanical and Microstructure Properties of Polypropylene Fibre Reinforced Concrete (PPFRC)

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Mohd Asri, Ammar Izuddin [a]; Saad, Siti Asmahani [a]; Wan Hassan, Wan Nur Firdaus [a]; Md. Husain, Nadiah [a]; Che Deraman, Siti Noratikah [a]; +1 author

[a] Department of Civil Engineering, Kulliyyah of Engineering, International Islamic University Malaysia, Kuala Lumpur, Malaysia

Abstract

Enhanced concrete strength can lead to increased brittleness and susceptibility to cracking. Traditional reinforcement methods with deformed steel bars aim to mitigate this problem, but corrosion issues can compromise the durability of concrete. Harsh weather like seawater can cause micro-cracks, allowing aggressive ions and water to penetrate and gradually deteriorate the concrete. Meanwhile, chemical reactions triggering steel corrosion led to rust formation, internal stress, cracking and delamination that caused structural risks. Fibre-reinforced concrete (FRC) offers a great solution by replacing steel bars with corrosion-resistant fibres hence improving both strength and flexibility. The study comprehensively analyses mechanical properties, particularly flexural strength, to assess how polypropylene fibre (PPF) affects FRC's overall strength.

Microstructure evaluations examine changes in pore structure and durability. The research also tests FRC performance cured in freshwater (FW) and seawater (SW) conditions. Based on this study, the low workability of fresh concrete was observed. This is due to the surface area increment in the concrete mix. Optimal PPF incorporation was recorded as 0.25% for compressive and flexural strength tests in both curing methods applied. Higher incorporation of PPF causes noncontinuous fibres congestion in the concrete mix. In this regard, it leads to the reduction of concrete strength which induces the formation of cracks. As for microstructure analysis, the sample with 0.25% PPF shows well-dispersed fibres throughout the concrete matrix. Therefore, it is proven that the inclusion of PPF in the concrete matrix improves the overall concrete performance.

Author keywords

Harsh environment exposure; Mechanical properties; Microstructure properties; Polypropylene fibre reinforced concrete (PPFRC)

Indexed keywords

Engineering controlled terms

Bars (metal); Bending strength; Compressive strength; Concrete mixers; Concrete mixtures; Corrosion resistance; Cracks; Curing; Fiber reinforced concrete; Fracture mechanics; Pore structure; Reinforced plastics; Steel corrosion; Steel fibers; Tensile strength

Engineering uncontrolled terms

Concrete performance; Concrete strength; Fiber-reinforced concretes; Harsh environment; Harsh environment exposure; Mechanical; Microstructures properties; Polypropylene fiber reinforced concrete; Property

Engineering main heading

Durability

Corresponding authors

Corresponding author	S.A. Saad
Affiliation	Department of Civil Engineering, Kulliyyah of Engineering, International Islamic University Malaysia, Kuala Lumpur, Malaysia

Email address asmahanisaad@iium.edu.my

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Corresponding authors