

DURABILITY OF PULTRUDED GFRP COMPOSITES WITH POLYESTER AND VINYL ESTER MATRICES UNDER FREEZE-THAW CYCLES

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ABSTRACT

This paper presents a study about the effects of freeze-thaw cycles (FTC) on the durability of 8 mm thick pultruded glass fibre-reinforced polymer (GFRP) composite laminates manufactured with unsaturated polyester (UP) and vinyl ester (VE) resins. After 100, 200, and 300 FTC, the retention of tensile, compressive, flexural, in-plane (IP), and interlaminar shear (ILSS) strengths in the longitudinal (pultrusion) direction were assessed under wet and dry conditions. The GFRP_UP exhibited the lowest retention of compressive strength, down to 73% under wet conditions after 100 FTC, with partial recovery to 85% after 300 FTC, while IP shear strength retention increased up to 111% under dry conditions after 100 FTC, followed by a reduction to 88% under wet conditions after 300 FTC. The GFRP_VE showed a better overall performance, with a tensile strength retention of 91% under wet conditions after 300 FTC. However, ILSS retention for GFRP_VE showed notable reductions, down to 77% under dry conditions. For both composites, the flexural strength exhibited small variations, suggesting that the flexural response was dominated by the fibre reinforcement and that fibre matrix adhesion remained effective throughout the exposure. The results highlight that while both composites exhibited satisfactory performance under FTC, the GFRP_VE generally showed better durability (maintaining higher retention of tensile, compressive, and in-plane shear strengths under wet conditions), although the GFRP_UP showed slightly higher retention of ILSS when exposed to moisture.

KEYWORDS

Glass-fibre reinforced polymer; unsaturated polyester; vinyl ester; pultruded; freeze-thaw cycles; durability.