

HYGROTHERMAL DURABILITY OF VACUUM-INFUSED THERMOPLASTIC COMPOSITES WITH GLASS FIBRES AND ACRYLIC RESIN

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ABSTRACT

Thermoplastic resins, particularly those based on acrylic, enable the production of continuous fibre composites with the potential for recycling and reprocessing. This represents a potentially decisive factor in the context of the growing volume of conventional thermoset composite waste being generated daily, for which sustainable end-of-life options are currently very limited. However, to enable the use of such composite systems in the construction industry, it is essential to guarantee that their durability meets the requirements of the sector. This paper presents the results of an ongoing study of the durability of glass-fibre reinforced polymer (GFRP) composites, designed for civil engineering structural applications, and produced by vacuum infusion using a novel thermoplastic acrylic resin. The hygrothermal durability of the thermoplastic composite was evaluated after 1, 3, and 6 months of immersion at 20 °C, 35 °C, and 50 °C, and was then compared with that of a reference thermoset composite made from unsaturated isophthalic polyester with identical fibre architecture. The physical, mechanical, and thermomechanical behaviours of the composites were evaluated through a series of experiments, including water absorption tests, tensile, flexural, interlaminar shear, and pin-bearing tests, as well as dynamic mechanical analysis. The results showed comparable property retention after ageing in the two types of composite, particularly for fibre-dominated properties. However, the thermoplastic composite exhibited two to three times higher water absorption and a greater susceptibility to the presence of moisture in the more matrix-dominated mechanical properties. These results were compared with the moisture conversion factor defined in the European Technical Specification CEN/TS 19101:2022, which presently only covers thermoset composites.

KEYWORDS

Thermoplastic acrylic resin; vacuum infusion process; glass-fibre reinforced polymer (GFRP); water absorption; mechanical properties; thermomechanical properties; durability; sustainability.