Durability of bio-based FRP composite materials for civil engineering structural applications

Summary

The objective of this research work is to assess the environmental long-term durability as well as sustainability of the bio-based FRP composites where bio-based thermoset polymer resins have been used to replace their petro-based counterparts reinforced with synthetic fibres such as carbon fibre, glass fibre, and basalt fibre.

The accelerated ageing environments considered are hygrothermal, thermal cycle, and freeze-thaw. Moreover, natural weathering of the FRP composites also will be assessed. Bio-based epoxy resin and bio-based unsaturated polyester (UPE) resin have been used to produce FRP (CFRP-Epoxy, GFRP-UPE, BFRP-UPE). The vacuum assisted resin infused method has been used for manufacturing the FRP composites. The bio-based UPE resin has been developed in polymer laboratory of IST. The damage caused by the environmental exposure mentioned above will be characterized through various physical, mechanical (tensile, compression, in-plane shear, and inter-laminar shear) and thermomechanical (dynamic mechanical analysis, DMA) analyses.

The results obtained from the assessment of the diverse environmental ageing, will be utilized to propose a long-term degradation model as well as defining conversion factors for the durability design of FRP composite within frame of future Eurocode (prEN 19101) for designing fibre-polymer composites structure. In addition, the environmental impact of the bio-based resins as well as FRP composites will be assessed using Life Cycle Assessment (LCA) tool.

Keywords

Carbon fibre reinforced polymer (CFRP), basalt fibre reinforced polymer (BFRP), glass fibre reinforced polymer (GFRP), bio-based epoxy, bio-based unsaturated polyester, environmental durability, hygrothermal, freeze-thaw, thermal cycle, LCA.

Resin synthesis and FRP composite production using vacuum infusion method.

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