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ENVIRONMENTAL DURABILITY OF KEVLAR COMPOSITES REINFORCED WITH TiO_2 NANOPARTICLES

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Keywords: Kevlar fabrics; Tensile testing; Bending testing

Abstract

In this research, the testing specimens were made from the Kevlar fabrics impregnated with 10 wt.% poly (vinyl butyral)/ethanol solution but with the addition of the TiO2 nanoparticles. The tensile and bending properties of the dry specimens were compared with the ones that had been immersed in a water bath filled with distilled water (40°C) in the period of 8 weeks.

The PVB/fabric weight ratio for the impregnation of the woven Kevlar fabric was 20 wt.%. The Kevlar/PVB fabric composites were reinforced with the TiO2 nanoparticles in different concentrations (1 wt.% or 2 wt.% of reinforcement regarding poly (vinyl butyral), PVB). The two layers of composite fabrics were hot-pressed by using the digital press at a temperature of 170 °C for 30 minutes.

The immersion of the square Kevlar/PVB composite specimens for the water weight gain measurements was performed according to the ISO 62 standard. The Kevlar/PVB specimens were tested in accordance with the ASTM D 3039 standard for the tensile properties and ASTM D 790-03 standard for the flexural properties.

During the tensile and the flexural test, the complete fracture of the specimens did not occur. The addition of 2 wt.% TiO2 nanoparticles produced 39.8% and 24.3% improvement in the tensile strength and tensile modulus, respectively, compared to the dry Kevlar/PVB specimens without reinforcement. The tensile properties of all the immersed Kevlar/PVB composite specimens had decreased values compared to the ones of their dry specimens.

Unlike the tensile test results, the best flexural properties (strength and modulus) were achieved with the dry specimens with no particles due to the better bonding between their two impregnated fabric layers since the presence of TiO2 nanoparticles reduced the shear connection between the layers. However, there was not such a decline in the properties of the wet specimens with nanoparticles which even made some improvement in the bending strength compared to the wet Kevlar/PVB specimens.