

Evaluation of the UV Stability of Unidirectional Crossply Ultrahigh-Molecular-Weight-Polyethylene Composite

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Abstract : Dyneema is an ultra-high molecular weight polyethylene (UHMWPE) fiber created by DSM. This fiber has many applications due to the high tensile strength, low weight, and inability to absorb water. DSM manufactures a non-woven unidirectional cross-ply [0,90]₂ lamina, using the Dyneema fiber. Using this lamina system, various thickness panels are created for a 40% lighter weight alternative to Kevlar for the same ballistics protection. Environmental effects on the ply/laminate system alter the material properties, resulting in diminished ultimate performance. Understanding the specific environmental parameters and characterizing the resulting material property degradation is essential for determining the safety and reliability of Dyneema in service. Two laminas were contrasted for their response to accelerated aging by UV, humidity, and temperature cycling. Both lamina contain the same fiber, SK-99, but differ in matrix composition, Dyneema HB-210 employs a polyurethane (PUR) based matrix, and HB-212 contains a rubber-based matrix. Each system was inspected using a scanning electron microscope (SEM) and evaluated by dynamic mechanical analysis (DMA) to characterize the material property changes alongside the corresponding composite damage and matrix failure mode over the aging parameters. Overall, resulting in the HB-212 degrading faster compared with the HB-210.

Keywords : dyneema, accelerated aging, polymers, ballistics protection, armor, DSM, kevlar, composites

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