BALLISTIC PERFORMANCE OF UHMWPE HEMISPHERICAL SHELLS

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ABSTRACT

The manufacturing of combat helmets, using traditional high performance fibers, makes use of well known fabrication techniques. Typically, fabrics impregnated with thermoset resins are inserted in a compression molding press, which operates at a given curing cycle. For example, aramid fabrics and phenolic based resins are commonly used in high volume production chains where cost is the most important design criterion. However, ballistic performance of aramid composites declines as a result of exposure to ultraviolet (UV) radiation or highly humid environment conditions.

Recently, new generations of thermoplastic composites, which offer higher ballistic protection at a lower weight per armored area, have been developed. Among these, unidirectional ultra high molecular weight polyethylene (UHMWPE) composites can be used for helmet manufacturing as they display superior strength to weight ratio, and offer chemical, UV and moisture resistance. Nonetheless, UHMWPE composites are not widely used because of both technical challenges during manufacturing, and their cost.

To contribute to the understanding of helmet manufacturing from UHMWPE composites, this paper presents the results of a research program on the fabrication of double curvature shells. Unidirectional UHMWPE sheets where compressed inside an aluminum hemispherical cavity mold. The Taguchi method, for design of experiments, was used to determine the optimum set of curing cycle parameters to maximize the ballistic performance of hemispherical shells.

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