Creep forming of high strength polyethylene fiber prepregs for the production of ballistic protection helmets.

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Composites Science and Technology 70 (2010) 1184–1188

Abstract

Production of highly three dimensionally curved composite products with continuous fibers so far is dependent on drapability of the fibrous precursor. Drapability depends on the in-plane shear compliance of the precursor and on its bending flexibility. Elongation of the fibers usually gives a negligible contribution to drapability because high performance fibers typically show small elongations to failure. However, high strength polyethylene fibers are an exception. They may accumulate considerable creep elongation, provided that the loading time is sufficiently long. Choosing a proper processing temperature, somewhat below the melting temperature, allows that this sufficiently long processing time is still within the limits that are acceptable for industrial production. This paper explores the technique for creep forming of high strength polyethylene fiber prepregs for the production of full scale ballistic protection helmet shells. Such helmets show a highly three dimensionally curvature. It was found that such helmets can be made by creep-forming indeed. The helmets were free of wrinkles and showed excellent protection against supersonic projectiles. It was found to be very important that a homogeneous temperature distribution is provided during creep forming. Very high fiber tensile stresses occur during creep forming. Control of these high creep stresses is necessary.