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INFLUENCE OF ENVIRONMENTAL DEGRADATION ON THE BALLISTIC BEHAVIOR OF POLYMERIC ARMOR MATERIALS

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Abstract

High resistance fibers, thanks to their superior performance, are used, either alone or as a reinforcement element, in several fields, from sport and recreation products to sophisticated structures for civil and military applications. Polymeric materials, such as polyester, epoxy, polyamide, aramid and polyethylene, in the form of fibers or fabrics, have been widely used, since World War II, by the military industry. Materials manufactured with aramid or ultra high molecular weight polyethylene fibers, that show a great capacity for absorbing the impact energy of projectiles, are employed in the production of lightweight polymeric armor, for personnel and vehicular protection. Soft armor is composed of multiple layers of fabric sealed into a covering and hard armor is a composite formed by woven or non-woven fabrics in a resin, thermorrigid or thermoplastic matrix sandwiched, usually, in a plastic film. Exposure of polymeric materials to environmental agents, such us radiations, humidity, heat, chemical products, microorganisms etc., causes macromolecular modifications which lead to aging and, frequently, to a degradation of the material properties. These agents depend strongly on local conditions and thus vary considerably from region to region and from country to country. The performance of polymeric armor made with high-modulus and high-strength fibers has been extensively investigated but very few studies were dedicated to the aging of these materials. In addition, high resistance fibers are often proprietary materials and published data about the influence of the environmental conditions on the behavior of polymeric armor materials are limited and sometimes contradictory. Therefore, investigation of degradation mechanisms is important for developing new polymeric armors and, in special, for predicting useful life of these materials. The results of academic research studies related to degradation of polymeric armor, carried out in the materials science graduate program of IME, will be reported and discussed. The research projects that are being contemplated for the near future will also be presented.

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