Honeywell Spectra®

Technical Bulletin

Z Shield® Material: UV Exposure Test Results

***Z Shield*Ò Material**

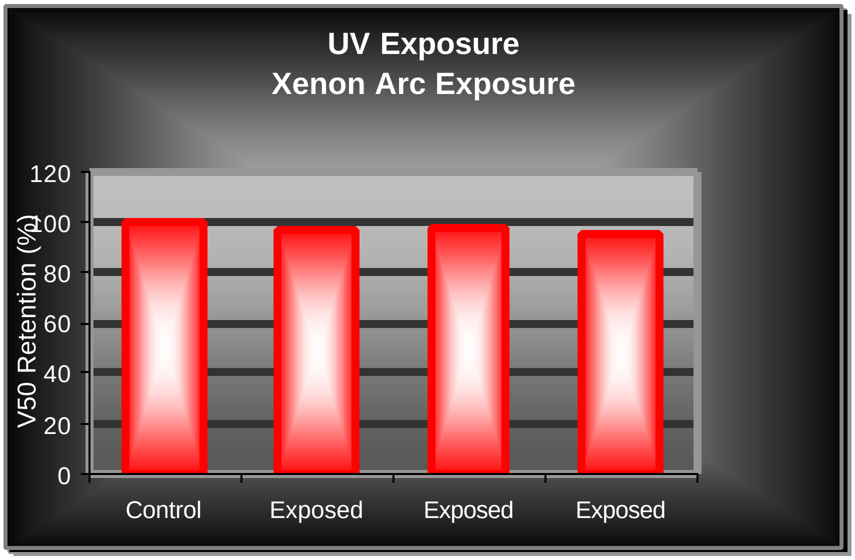
In 1998, Toyobo published information on the response of Zylon® fiber, also known as PBO [poly(p-phenylene-2, 6-benzobisoxazole)], to UV light exposure. Data published by Toyobo indicated that Zylon® fiber's tensile strength can deteriorate when exposed to UV light. Although ballistic material is enclosed in a protective cover when in use, there is a short period of time during the manufacturing of the material and subsequently during construction of the ballistic insert that the material could be exposed to UV light.

Zylon® fiber is utilized in Honeywell's patented shield technology process resulting in Z Shield® material. Z Shield® material is a non-woven, unidirectional composite cross-plied in a 0/90 degree orientation, and sandwiched in a thermoplastic film to form a laminated continuous roll. The composite is comprised of Zylon® fiber impregnated with a resin matrix. Z Shield® material is one of the highest performing ballistic materials for soft armor on a weight to performance basis.

Honeywell Spectra Technologies is an ISO 9000 registered business. Because of those requirements, Honeywell follows design protocols during the development of new materials. This includes evaluation of the material for its performance and quality as well as the steps for commercialization prescribed by the DFSS (Design for Six Sigma) program. In addition to the performance and quality standards that are established at the commercialization of a new product and adhered to during production of the material, supplemental testing programs are implemented to document other material properties. Hence, investigation into Z Shield® material performance after UV exposure was undertaken.

Test Protocol

Xenon arc testing, a standard test used to evaluate a material's response to different wavelengths of light, was performed. Xenon is a high intensity light source but cannot be directly correlated to other light sources. In other words, results from this test cannot be directly correlated to specific hours of exposure to UV light. This test does provide aggressive and accelerated testing for artificial UV light in an environmentally controlled environment. The test method employed was AATCC 16E, incorporating a 6500 W Xenon arc light source. The test chamber had a dry bulb temperature of 43ºC (109.4ºF) and 30 percent relative humidity. The energy exposure was equivalent to about 75 kJ/day/m^2. Samples were constructed of multi-layer, 18" x 18" sheets of Z Shield® material, assembled into shoot packs for ballistic evaluation after testing. The Z Shield® material shoot pack samples were positioned equidistant from the Xenon arc and exposed for 40 continuous hours in the chamber. The sample packs were not encased in a protective cover, as they would be in a ballistic resistant vest; therefore the raw material was exposed.



Visual examination of the samples after exposure showed the surface layer exposed to the Xenon arc exhibited a change in color, usually darker than the unexposed control samples. Proceeding from the top layer inwards, there was a gradual change in color, eventually merging into the color of the unexposed (control) product. However, even with the noticeable difference in some of the layers, ballistic testing of the material as conducted by V50 ballistic limit testing demonstrated less than a 3 percent drop in performance, within the testing variation of the product.

In addition to the Xenon arc testing, Z Shield® material was subjected to Arizona sunlight during summer months in a test conducted by DSET Laboratories, Inc. Again, 18" by 18" shoot pack samples of Z Shield® material were placed in glass enclosures where temperatures reached 85ºC (185ºF), and were exposed for 60 days continuously. The shoot packs were not encased in a protective cover, as they would be in a ballistic resistant vest. Under these extreme conditions, some ballistic performance degradation was documented supporting Toyobo's data around Zylon® fiber's tensile strength loss in response to continuous UV light exposure, particularly when coupled with high heat.

Accelerated aging testing, although typically related to temperature exposure, could also be related to light exposure as in UV testing, repetitive flex testing for flex fatigue, and washing. For a more detailed discussion concerning the challenges of drawing direct correlations between accelerated aging data and data generated from typical environmental conditions, please see the Honeywell Technical Bulletin titled, *Points to Consider When Interpreting Accelerated Aging Test Results.*

Conclusion

UV light alone, under short-term exposure as experienced in the production process for Z Shield® material and subsequent processes for the manufacture of ballistic resistant vests, does not seem to adversely affect the ballistic performance of Z Shield® material. However, there can be loss of performance after extended continuous exposure to UV light, especially when combined with extremely high temperatures. Consequently, precautions to minimize exposure to light are employed during the material manufacture, storage and shipping. Additionally, the Z Shield® material is shipped with best practice instructions for care and handling during the vest production process.

For more information about Honeywell's ballistic materials, please visit our Web site: www.spectrafiber.com, where you can also find information about our partnership with the National Tactical Officers Association (NTOA) and the Safe Today, Alive Tomorrow safety awareness program.

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