Honeywell Spectra®

Technical Bulletin

Interpreting Accelerated Aging Test Results

Points to Consider

The introduction of new products sometimes requires information about the extended life of the materials. Material 'aging' refers to the variation of its properties over time, both fundamental properties and those related to in-use application. Because full-life period, ambient aged samples usually do not exist, it can be necessary to conduct accelerated aging tests to provide experimental support of performance for these products until full-term data becomes available. The primary reason for using accelerated aging techniques in the qualification process is to bring the product to market at the earliest possible time. Accelerated aging techniques are typically used where the products can supply significant benefit to the end-user. However, development of the testing protocol can be difficult and complex.

Accelerated aging is defined as a procedure that seeks to determine the response of the material to normal-usage conditions over a relatively long time by subjecting the product, in a shorter time span, to stresses that are more severe or more frequently applied than that experienced under normal environmental or operational conditions. For example, in one of the more common forms, data taken at higher temperatures on a rapid time scale can be used to determine data at lower temperatures on a much slower time scale. Although accelerated aging techniques are well documented in some circles, information on the use of these techniques is limited in the ballistic protection field. As a result, accepted testing protocol or techniques, and hence related data, are almost non-existent.

In general a number of factors must be considered in conducting an accelerated aging study, regardless of the material or protocol employed. In establishing the accelerated aging test protocol, the environmental conditions selected should not represent unrealistic failure conditions that would not exist under real-time, ambient-aged conditions. For example, where there is an aging effect that occurs only in the presence of heat, one should perform tests at conditions of storage or use only. Accelerated aging also is only viable in situations where there is a simple relation of reaction to the stress environment. If there is indication that multiple chemical reactions, complex reactions with multiple environmental variables influencing performance, or potential for more than one type of reaction occurring at the same time, traditional methods of accelerated aging may not accurately predict performance. In these instances, elevated temperatures may negatively distort the performance of the material at operating or storage conditions. After consideration of the above and in order to have significant results for drawing relevant conclusions, substantial testing with control groups, adequate sample size populations, and multiple testing times must be conducted. This will allow use of appropriate statistical methods to establish data verity.

Results from accelerated aging work will generally be conservative – in other words the results will be indicative of a harsher environment than real-time aging. Because of this accepted trend, unrealistic negative data may be produced because of heat degradation. It is important to remember that typical accelerated aging is based on a zero-order reaction rate function and that supply of reactants remains constant throughout the study time frame. One must be alert for reaction-rate changing environments or situations that generate reactive radical groups sensitive to elevated temperatures.

Currently, there is no accepted and documented accelerated aging test protocol for ballistic materials. Consequently, the only predictor of performance is aging under normal conditions when full term data is available.

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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