K-Flex USA's Position On Accelerated UV Testing

Products, including insulation, jacketing, etc., must be either protected from or resistant to the degrading effects of ultraviolet light when used outdoors. It is well known that UV is not the only issue associated with products used outdoors and that there are many other factors to consider that might dictate the product be protected in some way, i.e. coating or jacketing. However, this bulletin only focuses on UV.

The primary factor in determining the harmful effects UV will have on a product is the amount of exposure. Exposure varies greatly depending on the climate zone, where the application is located on a job site, and time of year. Customer expectations for performance must also be taken into consideration.

Defining a product's UV resistance is also a difficult problem as one does not generally have the luxury of placing a product in the intended application conditions and waiting for years to see if it performs acceptably or not. Doing so would be considered a natural weathering test. Even this would not be a consistent test as the amount and intensity of UV exposure may vary from year to year, even in the same location.

As such, many manufacturers rely on accelerated aging tests to determine a product's UV resistance. Several issues associated with accelerated aging tests are noted below.

1. There is no direct correlation between accelerated aging tests and natural weathering or amongst different accelerated aging tests. Most accelerated aging tests have several caveats noted in their significance and use sections*. Two such caveats usually are 1) that correlation to natural aging is difficult and 2) that the test is best used for comparing two products, meaning that a control should always be run. Most tests provide a procedure only (no requirements listed) and are open to a wide range of options related to how the test is run, i.e. length of exposure, temperature, moisture, flexing, etc. Therefore, when evaluating claims relating to an accelerated aging test, the user must know exactly how the test was run and what the acceptance criteria was. Stating that a manufacturer passes or meets a test procedure, i.e. ASTM G90, has no substance and means nothing to the end user. In order to make a comparison to other materials or to determine if the product has the UV resistance the end user needs, more information needs to be supplied. A manufacturer that states that a product's performance "passes" such a test procedure is either ignorant of the facts or trying to mislead the market.

2. The following accelerated UV aging tests are commonly used to evaluate products.

    a. ASTM G7 – Standard Practice for Atmospheric Environmental Exposure Testing of Non-Metallic Materials
    b. ASTM G23 – Standard Practice for Operating Light Exposure Apparatus (Carbon Arc Type) with and without Water for Exposure of Non-Metallic Materials
    c. ASTM G26 – Standard Practice for Operating Light Exposure Apparatus (Xenon Arc Type) with and without Water for Exposure of Non-Metallic Materials
    d. ASTM G53 – Standard Practice for Operating Light and Water Exposure Apparatus (Fluorescent UV Condensation Type) for Exposure of Non-Metallic Materials
    e. ASTM G90 – Standard Practice for Performing Accelerated Outdoor Weathering of Non-Metallic Materials using Concentrated Natural Sunlight.

ASTM G7 and G90 rely on natural light and ASTM G23, 26, and 53 rely on artificial light for their respective UV exposure. Each of these tests can be used to compare materials for UV resistance.

Unfortunately, there is not a direct correlation between them. Also, with each test, the exact test parameters of the test must be identified.

One thing that all of the referenced tests have in common is that although they are called "accelerated", they still may take weeks or months to run depending on the material. Another commonality is that they are test procedures only, meaning that any pass/fail criteria would have to be found in another standard or document. Pass/fail criteria actually use a qualitative / quantitative grading scale, rather than just stating pass or fail. Results from such criteria would be listed as excellent (no effect) to very poor (very severe) rather than just pass/fail.

In conclusion, K-FLEX advises product specifiers and users to be wary of any manufacturer stating that their products "pass" a certain ASTM test method or practice without also listing the exact parameters of the test, the "pass" criteria, and how this compares to other products that are acceptable for the application.

*Below are excerpts from the significance and use sections of ASTM G7 and G90.

ASTM G7: Section 4 – Significance and Use

4.2 Because of year-to-year climatological variations, results from a single exposure test cannot be used to predict the absolute rate at which a material degrades. Several years of repeat exposures are needed to get an "average" test result for a given location.

4.6 It is strongly recommended that at least one control material be part of any exposure evaluation. When used, the control material shall meet the requirements of Terminology G113, and be of similar composition and construction compared to test specimens. It is preferable to use two control materials, one with relatively good durability and one with relatively poor durability. Unless otherwise specified, use at least two replicate specimens of each test and control material being exposed. Control materials included as part of a test shall be used for the purpose of comparing the performance of test materials relative to the controls.

ASTM G90: Section 4 – Significance and Use

4.2 The relative durability of materials in natural or field exposure can be very different depending on the location of the exposure because of differences in UV radiation, time of wetness, temperature, pollutants, and other factors. Therefore, even if results from a specific accelerated test condition are found to be useful for comparing the relative durability of materials exposed in a particular exterior location, it cannot be assumed that they will be useful for determining relative durability for a different location.

4.4 This practice is best used to compare the relative performance of materials tested at the same time in the same Fresnel reflector device. Because of possible variability between the same type of exposure devices, comparing the amount of degradation in materials exposed for the same duration or radiant energy at separate times, or in separate devices running the same test condition, is not recommended. This practice should not be used to establish a "pass/fail" approval of materials after a specific period of exposure unless performance comparisons are made relative to a reference material exposed simultaneously, or the variability in the test is defined so that statistically significant pass/fail judgments can be made.