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Drawing on decades of weathering leadership and expertise, the Atlas Consulting Group provides in-depth consulting services that assist you in developing and applying the best weathering test methods and strategies for your products. ***Atlas Weathering Consulting Insights*** offers interesting and valuable information on a variety of topics relevant to long-term durability testing.

Can't Find a Standard That Fits? Maybe You Could Use a Good Custom Tailor

This issue of the Atlas Weathering Consulting Insights Newsletter is the final installment of a six-part series on various aspects of weathering test tailoring - that is, adapting or creating weathering tests as appropriate for specific circumstances. This sixth installment addresses weathering testing for specific climate zones.

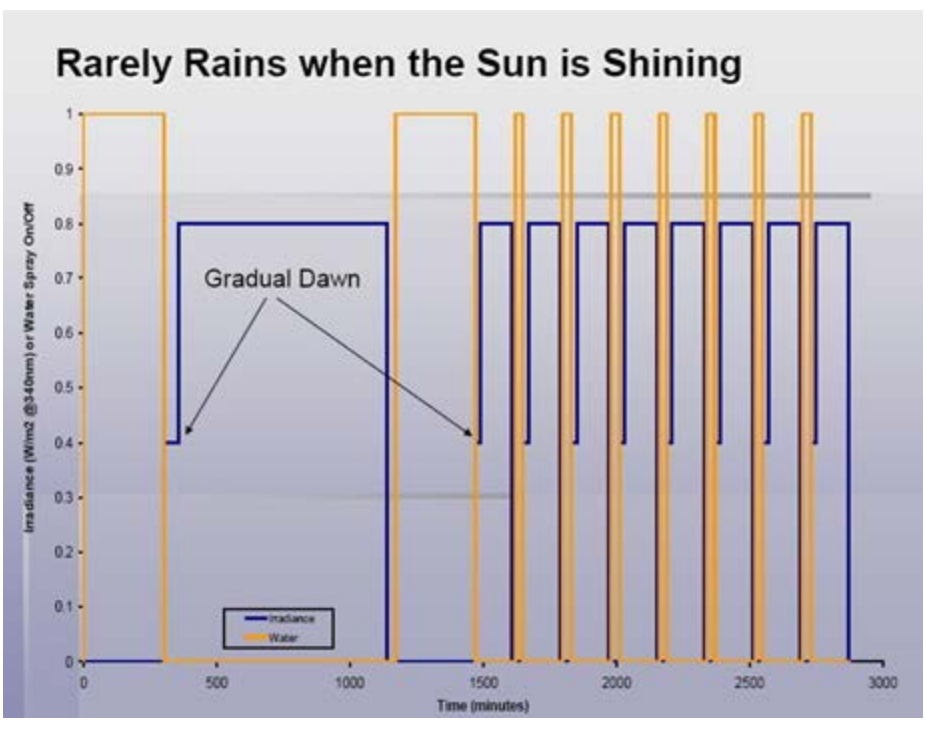
Weathering Test Tailoring Part 6: Climate Specific Weathering Testing

An important aspect in weathering testing is the concept of "test tailoring," In other words, the overall approach must be appropriate for the product and the testing objective. This is particularly true when trying to relate laboratory weathering test performance to that in a particular service environment. In most cases, standard weathering test methods are not designed, nor claim, to represent or predict performance in any specific climate, such as the common South Florida benchmark. In many weatherability projects, it is necessary to modify existing test methods, or design new ones, to better simulate a target climate while still providing a reasonable level of overstress test acceleration in order to be useful.

For many years, climate zones like South Florida and Central Arizona in the US, and the Kalahari Desert in South Africa have served as reference climates for the qualification of products due to their relatively limited annual weather variance. These locations also represent some of the harshest climates on earth. They provide intensified temperature and solar radiation compared to Europe and the Northern parts of the American and Asian continents, where for many years the center of the global buying power was concentrated. These days, global wealth is increasing and markets like India, China and Brazil have gained significantly in commercial importance. Products targeted for the outdoors in these emerging markets must often withstand very different and often quite severe climate conditions. However, for these areas the established reference sites may not provide any acceleration or intensification of weather factors. This complicates the development of long-term durable products like automotive coatings, architectural coatings and textiles, window frames, window blinds, photovoltaics, etc, for these markets. Results and experiences of product performance in more moderate climate zones cannot necessarily be transferred directly and might not be sufficient. Thus, accelerated weathering is highly attractive for product qualification in many of these emerging markets.

If a product is developed for one specific market or climate zone, a weathering test method reflecting this climate zone is the best option. This is not a new concept and currently exists in many specifications and standards such as SAE J2527, PV3930 for humid environments and PV3929 for arid environments. The latest and maybe most prominent example is the ASTM D7869 standard, which combines a realistic spectral power distribution of a filtered xenon-arc light source with a more realistic temperature and moisture delivery cycle characteristic of benchmark South Florida. Long moisture soaking times in the dark and irradiance above the natural level, combined with a high frequency of light/dry and humid/dark cycles provide acceleration of chemical and mechanical degradation pathways compared to South Florida outdoor exposures and result in similar damage patterns of automotive and aerospace paint systems.

For example, D7869 includes long moisture soaks for maximum coating uptake, followed by a multi-step irradiance profile to better mimic the gradually warming and cooling cycle of a day in Florida, followed by a series of short "daily" cycles for test acceleration, all within 24-hours, as shown in the figure below.



*Test sequence according to ASTM D7869 - An improved accelerated weathering protocol to anticipate florida exposure behavior of coatings**

However, as improved as this cycle may be over previous tests, it still only mimics one specific climate zone. Today however, products are developed for various climates or oftentimes, the end-use location of a product may be global or perhaps not be fully known. Results from testing to a hot/humid environment (like ASTM D7869) cannot automatically be transferred to arid or moderate climate zones. Therefore, in principle, there are four options for qualifying products for other or multiple climate zones:

- The test represents a specific climate zone, which may be the worst case, but the results can be transferred to other end-use locations.
- Separate product samples are tested under two or more independent test conditions, such as the boundary conditions, to represent the suspected most and least severe climates.
- A single product sample undergoes a sequence of test cycles representing a variety of climate zones; this is especially applicable to mobile rather than fixed-location use products.
- The product is tested to a "global composite" theoretical (but not necessarily existing) worst case simulated climate condition, defined by global highs and lows of solar, temperature and humidity cycles. Often, short screening tests in a Design of Experiment are required to determine the appropriate stress parameters and levels, especially if there are interaction effects (synergies) between the climate factors.

The choice of which is the best option for your product depends upon the product or material and its potential failure pathway, but also on testing time, available equipment, potential risk of failure vs. testing effort, and testing budget. However, no accelerated test method can completely simulate the end-use environment of a product. Therefore, it is always highly recommended to confirm accelerated weathering with outdoor exposures at test sites close or similar to the end-use environment, even if business decisions must be made on the interim accelerated tests. As outdoor exposures progress, the risk of extrapolation from short term accelerated tests will diminish and confidence in the performance of your product will increase.

Oftentimes, real world products face unique conditions which mandate custom-tailored test programs as there may be no specific product or test standards by which to refer. If you should have such a product, contact the Atlas Consulting Group at atlas.info@ametek.com (US) or atlas.info@ametek.de (Europe) to help you. The Atlas Consulting Group specializes in test tailoring, designing and implementing testing programs for clients to yield meaningful and useful results on a cost effective basis.

*Source: Mark Nichols, John Boisseau, Lynn Pattison, Don Campbell, Jeff Quill, Jacob Zhang, Don Smith, Karen Henderson, Jill Seebergh, Douglas Berry, Tony Misovski, and Cindy Peters, Journal of Coatings Technology and Research, March 2013, Volume 10, Issue 2, pp 153-173.

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