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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 fifth 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. The first installment covered special mechanical stresses.

Weathering Test Tailoring Part 5: The Side Effects of Weather

In weathering, we preach that the combined effects of weather act synergistically and are much more damaging than the sum of their parts; weathering often involves both chemical and physical degradation mechanisms. Only if all factors are applied simultaneously, as in nature, is it likely to simulate realistic degradation. However, in accelerated weathering, a considerable amount of effort is spent on the realistic simulation of radiation, temperature and humidity. These primary factors are regulated and controlled in detail but often, standard weathering test methods neglect the importance of cycling of these variables. Further, there are additional stress factors that may be potentially dangerous for your products in their end-use environments such as acid rain, salt water, freeze/thaw, cleaning agents, and also biologicals such as algae and fungi growth or bird droppings.

Is there a synergistic effect with these stressors as well? Or is it sufficient to test these factors independently? Do they have to be combined with standard weathering and if so, how?

Since standard weathering instruments are usually not capable of applying an additional stressor such as acid or salt solutions, at least not without severely damaging themselves, alternative methods must be found to apply additional "weather factors."

One way is to pre-soak the test specimen with a detrimental chemical before it is exposed in a weathering instrument. An example is the so called "perspiration and light test" for textiles, where artificial sweat solution is applied so the effect of sweat on the lightfastness (color change) can be investigated (refer to ISO 105-B07).

When stresses cannot be applied simultaneously, it may be necessary to apply the additional stressors in a sequential or alternating manner. It may not always be the ideal since some synergistic effects might not occur exactly as in nature but often, it is the only technically feasible way to combine laboratory weathering with an additional stressor.

One example is the alternating application of salt spray and weathering (or UV stability testing) as described in ISO 20340 for protective paint systems for offshore structures. However, there are two downsides to this procedure: one is that synergistic effects ("interaction effects" in Design of Experiment terminology) might be missed or underestimated; the other is that the individual stress factors do not act for the entire test time. To try to do so would greatly extend the testing time required for a specific exposure.

Physical damage from cyclic stresses such as humidity or temperature cycles which lead to expansion or swelling of materials and then shrinking might be considered as a "secondary factor" as well. For example, moisture cycling, in combination with UV exposure, often produces micro-cracks in plastics that either exposure alone does not.

Some environmental chambers are capable of combining temperature cycling with solar stability testing. However, cool and/or dark periods might increase the testing time. In weathering tests, periods without radiation may be required for slow diffusion processes, moisture saturation and so-called "dark processes" such as the reversion of photoisomers. This drawback of increased testing time to reach a radiant energy target sometimes can be overcome, for example, by increasing the irradiance during the light period, such as in the new ASTM D7869, where dark water soaking periods are compensated for by alternating with exposure at higher than typical irradiance levels.

However, sometimes it may be better to investigate physical and chemical aging with different tests on different samples. These "pre-screening" studies can help to confirm or eliminate the need for specific stressors or stress combinations as the comprehensive "realistic simulation" might be too slow or too expensive to implement.

A prime example of a testing sequence using combinations of different simultaneous and sequential or alternating exposures is the advanced Atlas 25+® program developed for photovoltaic (solar energy) modules. Here, different tests are applied to photovoltaic modules starting with a sequence of UV exposure, salt-spray, condensing humidity, thermal-solar-moisture cycling alternated with thermal-solar – moisture/freeze cycling to simulate seasonality, and finally outdoor accelerated exposure. The program is a realistic approach to address both the technical and economic aspects of testing when trying to reproduce the complex phenomenon we simply call "weather."

What provides more realistic results versus what is more economical can vary significantly from product to product and from test to test. The Atlas Consulting Group specializes in test tailoring and designing and implementing testing programs for clients to yield meaningful and useful results on a cost effective basis. If you have a product requiring a comprehensive weathering evaluation, contact the Atlas Consulting Group at **atlas.info@ametek.com** (US) or **atlas.info@ametek.de** (Europe) to help you.

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