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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 first 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.

Weathering Test Tailoring Part 1: Additional mechanical stresses

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 involves many inter-related product factors - materials, design, performance requirements, analytical considerations, service environment conditions, test equipment capabilities, etc. Often, this requires non-standard techniques to get the optimum, most reliable, product specific, custom-tailored test plan.

Many of the core concepts of test tailoring are described in MIL STD 810G *Environmental Engineering Considerations and Laboratory Tests*. Both external environmental (e.g., weather) and service use (e.g., mechanical) stresses need to be considered. One of the Atlas Consulting Group's projects involved concentrated solar power (CSP) systems. Usually located in hot desert environments, these very large scale systems involve solar tracking mirrors to concentrate sunlight, the heat of which is harnessed to drive electrical generators. CSP configurations may include "power tower," parabolic trough or linear Fresnel reflector designs. This particular project involved evaluating the suitability and long-term durability of a matrix of glass mirrors with backside-coatings and elastomeric adhesive combinations used for mounting the mirrors to a steel tracking structure.

In addition to the environmental stress of desert temperature cycling extremes, high solar radiation, wind load, etc., there was also physical stress from the mechanical tracking of the sun. Further, at night or in high winds, the devices would go into a protective inverted "stow" position. During the day, the adhesives would experience compressive and torsion stresses as well as lateral shear. During stow, the stresses would transition to shear stresses and finally to a combination of shear and tensile stresses. Scale-up studies showed that the dominant field failure mechanism was a combination of peel adhesion and tensile failure.

To tailor the exposure, a desert-climate derived solar/environmental accelerated laboratory test cycle was developed, with the added element of water to simulate periodic mirror maintenance washing, scarce rain or dew. A special test fixture was designed which mechanically loaded (to scale) the mirror/substrate test specimens with a combination peel/shear adhesion stress over a test duration of several months.

The analytical methodology also required custom tailoring. A standard mechanical test system (i.e., tensile tester) was fitted with a test fixture, custom designed for this project. This was necessary to retain the fragile mirrors, but also allow for lateral sliding movement during a combined tensile/shear pull to keep the mirror and crosshead properly aligned. Destructive tests were conducted on multiple replicates and at exposure intervals to determine the stress/strain curves and failure modes. From this data, a clear picture of the acceptable mirror/coating and adhesive system combinations emerged.

Representative example of one type of concentrated solar power system. For client confidentiality, this is not the actual product used, but is similar in concept.

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.

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