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An Open Letter to our Customer interested in Correlation:

At least once a month I get the very same question posed: "How many hours in a Weather-Ometer (or Q-Sun or QUV) is equal to a year in Florida (or a store window, or similar)?"

As you could probably guess, this quest for definitive correlation is as old as artificial weathering itself (circa 1918) and as elusive as the Holy Grail. The simple fact is that any acceleration over real-time exposure is often material dependent, even when the substance is essentially in a pure state. However, since most materials are not pure, the situation is even more complex because of these other influencing factors, a few of which are listed below:

(1) Contamination with other materials (e.g. catalyst residues, residual monomer, regrind)
(2) Processed-in degradation (thermal or photodegradation history during processing in the open atmosphere)
(3) The interaction of all the compounded additives such as dyes and pigments, stabilizers, lubricating agents, modifiers, viscosity improvers, fillers, etc., etc., etc..
(4) MORPHOLOGY: Thin film vs. molded part, or, in the case of packaged materials, the nature of the package itself.

On the flip side of the weathering correlation equation, how do you correlate to a moving target? Weather and climate, even in the same location, are highly variable events. Statistical averages do not represent the range of extremes that may be responsible for material degradation. Numerically, the list of variables in the area of direct exposures is at least as long as materials list above:

(1) Solar Irradiance
(2) Solar Angle (path of Sunlight through the atmosphere)
(3) Temperature
(4) Humidity
(5) Elevation
(6) Pollution
(7) Sample Angle (mounting angle)

The lengthy list of "Real World" variables is the main reason why the most common method of estimating acceleration does not work: COMPARISON OF MEASURED RADIANT ENERGY (especially in the ultraviolet). This technique, of course, is tempting because light energy is fairly easy to quantify. However, such a calculation takes into account only ONE of the

ELEVEN variables documented above. All of the other synergistic effects are ignored in this simplistic approach, and these influences can be substantial.

As an example of this, Ford Motor Company presented some work at the recent International Coatings Exhibition establishing weathering "harshness" rankings for various geographical locations relative to south Florida. These included biased ranking for average daylight, temperature and humidity. The U.S. median value was that 2 years in-service for automotive coatings equated to one year south Florida exposure. This agreed with the general observation that Miami exposures are twice as fast as Michigan exposures. Florida exposures are harsher than Arizona for Automotive coatings, but the simple light irradiance extrapolation would predict the opposite, that Arizona is 25% harsher than Florida. Comparing light energy dosages only ignores the real effects of high Florida moisture on the degradation process.

Having made all of these disclaimers, we are well aware that people still want some idea of how Accelerated Laboratory Weathering Devices testing compares to the real world. In general, we often hear reported that when running the better xenon test methods (such as the SAE automotive methods), an acceleration factor of 4 or 5 over Miami exposures is generally seen.

Going back to a simplistic approach, DIRECT sunlight exposure amounts to about 280 Megajoules of UV energy per year. An Accelerated Weathering Device running the low irradiance ASTM G 155 test for 365 days would expose samples as follows:

40 W/m^2 x 1 joule-sec/w x 3600 sec/hr x 24 hrs/day x 365 days/yr x 1 Megajoule/1,000,000 joules = 1,261 Megajoules/m^2 per year.

By strange coincidence, this procedure yields a result very similar to the number mentioned in the previous paragraph: an acceleration of 4.5 to one. However, this IS a coincidence. I performed a real study of this type many years ago on Automotive Seating Materials and got an acceleration factor of 6 to 1, with an excellent correlation coefficient of 0.9, so I know that our experiment was performed to good standards.

The best and most accurate way to measure acceleration is to do your own testing:

(1) Establish a benchmark exposure area and type; often this is a worst-case scenario such as Florida or Arizona.
(2) Determine the variable(s) that will be measured to determine degradation.
(3) Run an Accelerated Weathering Device with conditions as close as possible to your established benchmark.
(4) Remember that the samples to be tested should be MATCHED SAMPLES; that is, identical pairs; wherever possible, a single piece should be divided in two; one sample is to be tested in the Weathering Device and the other exposed in the real world.

(5) Running the test correctly requires good laboratory procedures, but also, perhaps most importantly, good common sense. Often, the easiest way to measure acceleration is to simply determine how long it takes to get a failure point with both modes of testing.

For information on contract laboratory exposure testing, you may visit our SolarSystems website where we have materials for our real world testing sites: http://www.SolarSys.biz. If you would like a quotation on contract testing, please contact our office.

I am sure that you will still have further questions. As stated before, this letter is not the final answer, but is only designed to generate thinking on your part. Please don't hesitate to contact me for more information.

Sincerely,
SolarSystems & Solutions, LLC

Al Jamison
President