ATLAS MATERIAL TESTING SOLUTIONS
AMETEK MEASUREMENT & CALIBRATION TECHNOLOGIES

SunSpots®

Material Testing Product and Technology News

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Fall 2016

Light, Weathering and the Numbers Game

By Allen Zielnik, Senior Consultant Weathering Science and Matt McGreer, Product Manager, Atlas Material Testing Technology, LLC

The weathering behavior of organic (principally polymeric) materials exposed to the outdoor environment involves many factors. These include not only the applied stresses of the local weather and their variations over time, but also any in-service related use stresses, such as tensile, compressive, or shear forces, as well as the unique and specific degradation pathways of the material or product under those combined conditions. By extension, we can also say that "weathering" (though we are not able to use that specific term) includes the response of any material to the stresses of its service environment (e.g., automotive cabin or retail store).

Material Degradation

In general, an exposed material can degrade or change in important properties — e.g., appearance or mechanical strength — by one or more of several different mechanisms [1]. These include but are not limited to:

- Physio-mechanical process not involving any chemical change
- Photolytic effects from interacting with photons from terrestrial solar radiation or artificial sources
- Reactions with external chemical agents, including ozone, cleaning agents, acid/alkali, water, and others
- Free radical reactions with degradation products formed within the material during exposure

Often, one or more of these processes occur either simultaneously or sequentially. They may be synergistic in combination, and they may occur at different rates or affect different material properties. For example, the majority of polymers follow the general "autocatalytic photo-oxidation cycle" [2], whereby photons initiate the process of bond cleavage but further chemical changes are mostly driven by thermally driven free radical processes.

These factors, coupled with the inherent variability and often cyclic nature of the service environment, present major obstacles in designing and implementing a testing methodology. Even real-time natural exposure in an environment is dependent on the repeatability of the stresses and the faithfulness of the test specimen in representing the end use product. When we strive to accelerate these stresses in order to produce shorter test times, the complexity increases exponentially.

Continued on page 4

ATLAS 25+ Comprehensive PV Durability Testing

First Solar Completes Atlas 25+® Testing Program for Second Time
(Page 10)

In This Issue

CLIENT EDUCATION • ATLAS •

Keep Your Team Up to Date!

Fundamentals of Weathering I

November 8, 2016	Ghent, Belgium	Presented in Dutch
November 17, 2016	Paris, France	Presented in French
November 23, 2016	Dresden, Germany	Presented in German
March 8, 2017	Phoenix, AZ, USA	Presented in English
April 19, 2017	Mount Prospect, IL, USA	Presented in English
June 27, 2017	Freiburg, Germany	Presented in German
July 19, 2017	Mount Prospect, IL, USA	Presented in English
October 4, 2017	Mount Prospect, IL, USA	Presented in English
November 14, 2017	Kassel, Germany	Presented in German

Fundamentals of Weathering II

November 9, 2016	Ghent, Belgium	Presented in English
November 18, 2016	Paris, France	Presented in French
November 24, 2016	Dresden, Germany	Presented in German
March 9, 2017	Phoenix, AZ, USA	Presented in English
June 28, 2017	Freiburg, Germany	Presented in German
November 15, 2017	Kassel, Germany	Presented in German

Xenotest® Workshop

September 19–20, 2017	Linsengericht, Germany	Presented in German

SUNTEST® Workshop

September 22, 2017	Linsengericht, Germany	Presented in German

Weather-Ometer® Workshop

April 18, 2017	Mount Prospect, IL, USA	Presented in English
July 18, 2017	Mount Prospect, IL, USA	Presented in English
October 3, 2017	Mount Prospect, IL, USA	Presented in English

For the latest course offerings or to register for a course, please visit **www.atlasmtt.com/courses.**

ATLAS • SPEAKS

Pharma EXPO Show 2016 - Innovation Stage

November 8, 2016 • 11:00 am
McCormick Place, W-320
Chicago, IL, USA

“Photostability Testing of Pharmaceuticals and Protective Packaging: An Insider’s Guide to Your Testing Options”

Presenter: Allen Zielnik, Atlas Material Testing Technology LLC

Visit **www.atlasmtt.com/speaks** for details on upcoming Atlas conferences and speaking events.

K Show 2016
October 19–26, 2016
Düsseldorf, Germany
Booth #10D41

ITMA China
October 21–25, 2016
Shanghai, China
Hall 5, Booth F67 (SDL Atlas booth)

Pharma Expo
November 6–9, 2016
Chicago, IL, USA
Booth #W-576

P-MEC India
November 21–23, 2016
Mumbai, India
Booth #T27, Hall 7

ChinaCoat
November 30–December 2, 2016
Guangzhou, China
Booth #11.2C40/42

Visit Atlas' booth at these shows to learn about the latest weathering developments and how we can help advance your testing program.

For a complete list of Atlas shows, visit http://atlas-mts.com/news-events/trade-shows/

in-cosmetics
April 4–6, 2017
London, United Kingdom
Booth #EE47

European Coatings Show
April 4–6, 2017
Nuremberg, Germany
Hall 5, Booth #5-344

Asia Pacific Coatings Show 2017
September 13–15, 2017
Jakarta, Indonesia
Booth #D19

Atlas India Receives ISO 17025 Accreditation

Atlas is pleased to announce that our team in India, under the name Ametek Instruments India Private Limited, has been awarded ISO 17025 Accreditation by the American Association for Laboratory Accreditation (A2LA).

ISO 17025 is a global standard for the technical competence of calibration and testing laboratories. It was developed to recognize calibration and testing laboratories for their technical competencies through accurate, repeatable, and verifiable measurements.

Certificate Number: 2101.01

Atlas' service engineers in India now offer field calibration services and certificates accredited by A2LA to meet ISO 17025 requirements for irradiance, temperature, and humidity parameters — including documentation for traceability — on all Atlas instruments.

When coupled with AMECARE, our regular maintenance offering, this ISO 17025 accredited calibration ensures smooth, reliable, trouble-free operation of Atlas' high-quality testing instruments and assures customers that they are achieving the repeatable and reproducible test results they desire.

For more information on Atlas' accreditations, visit **www.atlasmtt.com/a2la.**

Light, Weathering and the Numbers Game, from page 1

Principal Weathering Stress Factors

Historically — and for good reason — natural and laboratory accelerated weathering tests have focused on the principal stresses of heat, light, and moisture, sometimes referred to as the "weathering trilogy." This is not to say that "secondary" environmental stresses such as atmospheric gases or acid rain are unimportant. Indeed, for some degradation mechanisms they are a significant factor. But for the majority of materials, these secondary stresses a) play a lesser or more specialized role in weathering and b) are difficult or impossible to add to existing accelerated tests or equipment.

In any natural environment, the trilogy stress factors vary in both daily (diurnal) and longer-term seasonal (and longer) cycles. But short-term fluctuations such as passing clouds and rain can affect stress levels as well. As we say, "Climate is what you expect, weather is what you get." These main weathering stress factors are interrelated (heat affects moisture, for example), so the more their natural balance deviates from real-world conditions, the more likely it is that the exposures will not correlate. Also, not all of the trilogy stress factors can be "accelerated" at the same rate, often leading to decreasing correlation at higher test acceleration attempts.

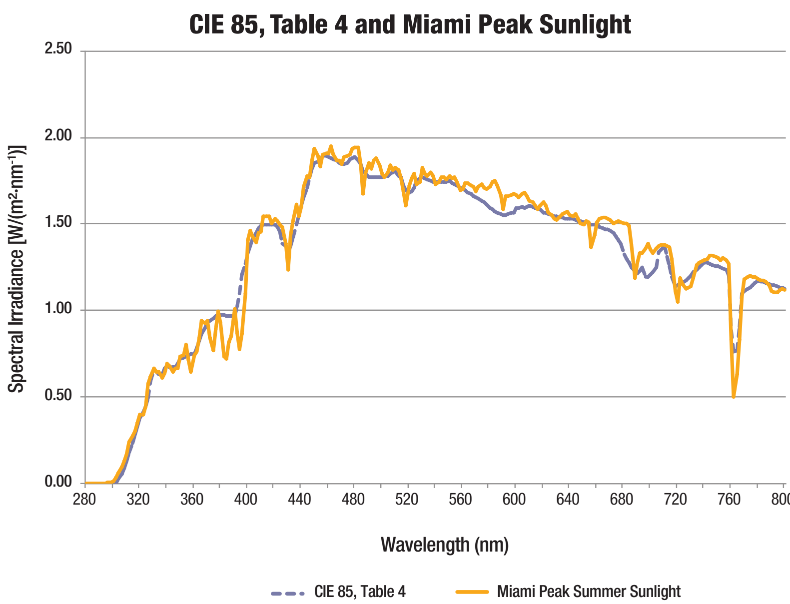

Figure 1. CIE Publication 85 Table 4 reference vs. Miami peak summer sunlight measured spectral power distributions

Therefore, the common question "How long must I expose my material in a laboratory weathering device to match its performance after one year of exposure in Florida (or other locale)?" is more complex than many realize — especially to those not heavily immersed in weathering science.

The inability to absolutely characterize the dynamic conditions of light, moisture, temperature, and atmospheric pollutants of a specimen's microclimate for the duration of its exposure presents the greatest obstacle to definitively answering *the question.*

However, advances in the delivery, control, and measurement of light — frequently the most important stress factor in the organic material weathering process — provide a starting point for making comparisons between laboratory and natural exposures.

The Spectral Quality of "Light"

The term *light* technically refers only to electromagnetic wavelengths detectable by the unaided human eye (between about 400 nm and 700 nm). While *light* applies to most artificially illuminated, principally indoor, conditions, the term *terrestrial solar radiation* applies to most full solar spectrum outdoor exposures. However, in common practice, the non-scientific terms *sunlight, daylight,* or *UV light* are often used.

The first law of photochemistry, the Grotthuss-Draper law, states that light must be absorbed by a compound in order for a photochemical reaction to take place. In photochemistry, suffice it to say that various structures in a molecule, loosely defined as *chromophores,* can absorb photon energy at certain frequencies. In photodegradation, this energy can result in bond scission and subsequent chemical reactions, many of which degrade the desirable material properties. Since photon energy is inversely related to wavelength by Planck's law, the lower wavelengths of ultraviolet radiation are typically more damaging, although undesirable photochemistry can result from longer wavelengths as well.

Because of this material-specific wavelength dependency, the *spectral power distribution* (SPD) of the radiation source is critically important; for weathering purposes, the SPD should match that of terrestrial solar radiation as closely as possible. Although "sunlight" varies with many factors, the most common target reference spectrum used in international weathering standards is the one represented in the Commission Internationale De L'Eclairage (CIE), Publication 85, Table 4 [3].

As Miami is often used as a critical weathering benchmark, Figure 1 shows the CIE reference and measured summer data at Atlas' South Florida Test Site (Miami).

To date, filtered xenon arc has emerged as the closest spectral match to direct and glass-filtered terrestrial solar radiation for commercial scale laboratory weathering applications. This is largely due to the inherent nature of the pure xenon gas discharge spectrum. However, slight variations in the SPD will occur in different xenon arc instruments depending on the lamp and instrument geometry, lamp cooling method (air vs. water), and availability of special optical filter glass in various shapes and transmittance characteristics. A comparison of several of Atlas "daylight" filter system SPDs are shown in Figure 2, and a comparison of window glass filtered SPDs is shown in Figure 3.

Note that despite minor differences between xenon lamp and filter technologies, the spectra are not only quite similar, but also very close to both standard reference and measured Miami sunlight, particularly in the critical low-UV wavelengths. Also note that not all of Atlas' filter combinations are shown, only those most commonly used.

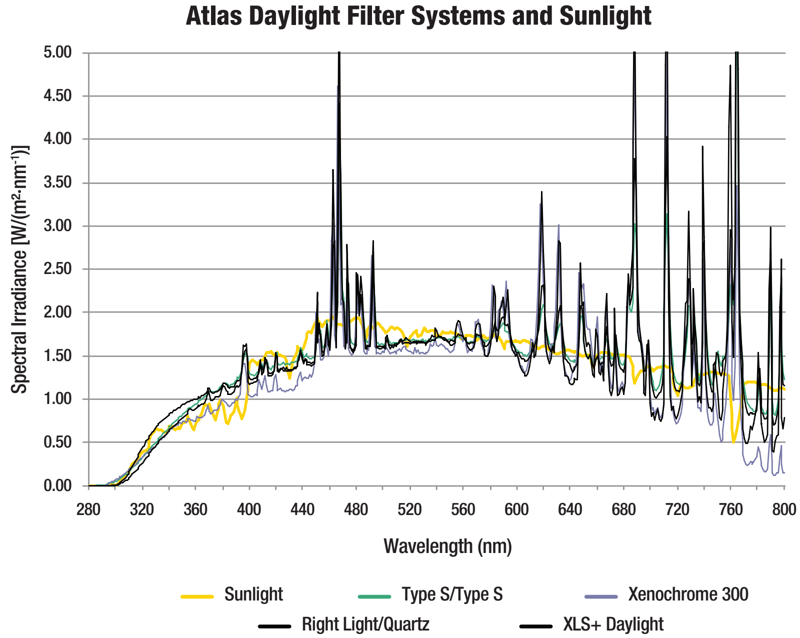

Figure 2. Spectral power distributions of common xenon "daylight" filters and Miami 26° south facing peak Miami summer sunlight. Data normalized at 560 nm.

Alternative Light Sources

Special metal halide lamps, equipped with either daylight or window glass filters, are also used in large-scale weathering applications. Metal halide has the advantage of higher light output vs. electrical power than xenon, but requires operation over a narrow power range or else the SPD is affected. While not as good as filtered xenon in matching the terrestrial solar spectrum, it is a practical alternative to xenon when large (e.g., walk-in or drive-in) chambers are required (Figure 4).

Fluorescent tube black light lamps are used in fluorescent condensation instruments. As these lack the longer UV and visible wavelengths, they are spectrally deficient when compared to sunlight; however, the UVA-340 lamp is a good spectral match for the lower half of the terrestrial solar UV. Fluorescent condensation does enjoy wide usage, particularly in UV/moisture screening for coatings resins on metal test panels. For details on weathering test factors that can decrease correlation with outdoor exposures, refer to the guidance in ISO 4892-1 [4], mirrored in ASTM G151 [5].

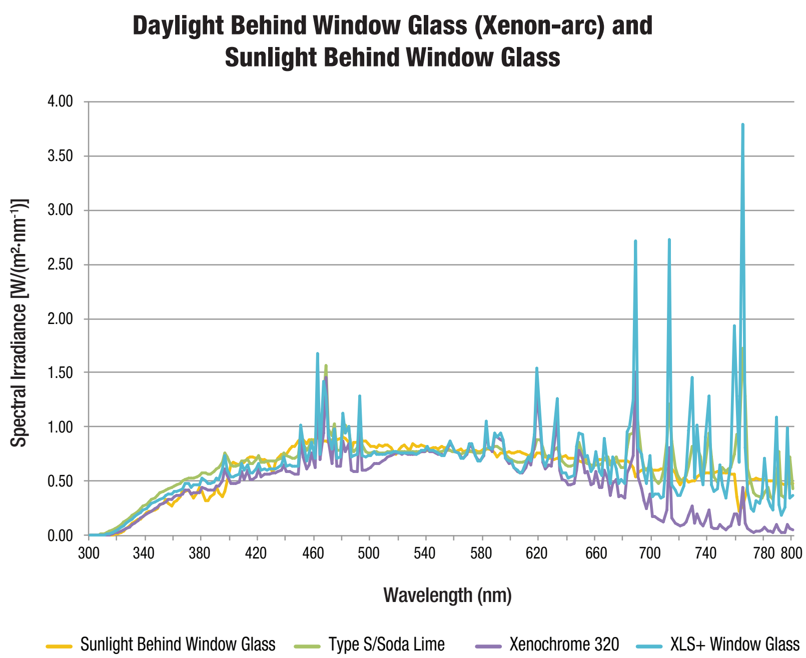

Figure 3. Spectral power distributions of "window glass" xenon filter and Miami 26° under glass south facing peak Miami summer sunlight. Data normalized at 560 nm.

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Light, Weathering and the Numbers Game, from previous page

It should be noted that the UVB-313 lamp emits wavelengths of UV-C that do not reach the earth's surface. The overarching international standards for fluorescent UV lamps (ISO 4892-3 [6] and ASTM G154 [7]) contain specific cautionary notes that "these lamps may result in aging processes not occurring outdoors" and "use of this lamp is not recommended for sunlight simulation," although they are known to be used for this purpose (*caveat emptor,* "let the buyer beware").

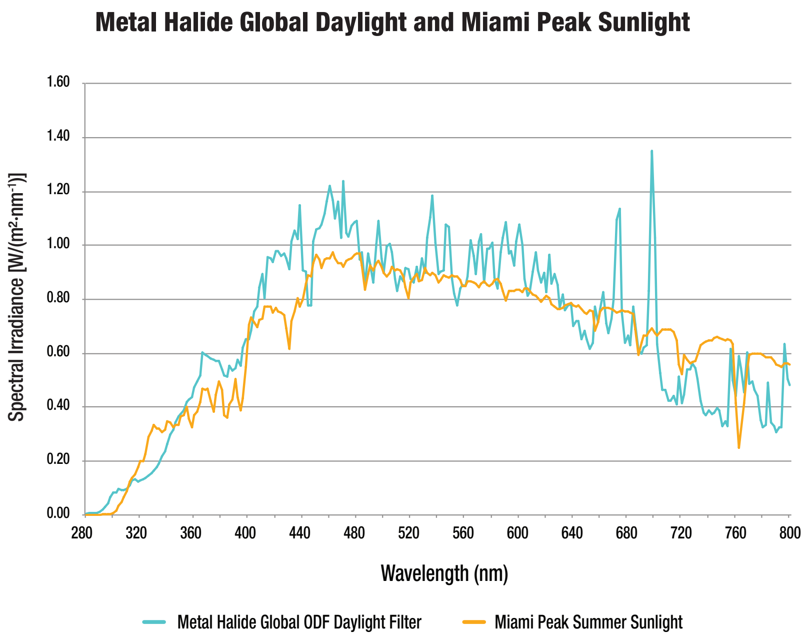


Figure 4. SPD of Atlas' Metal Halide Global (MHG) lamp with daylight filter compared to peak summer Miami sunlight. Data normalized at 560 nm.

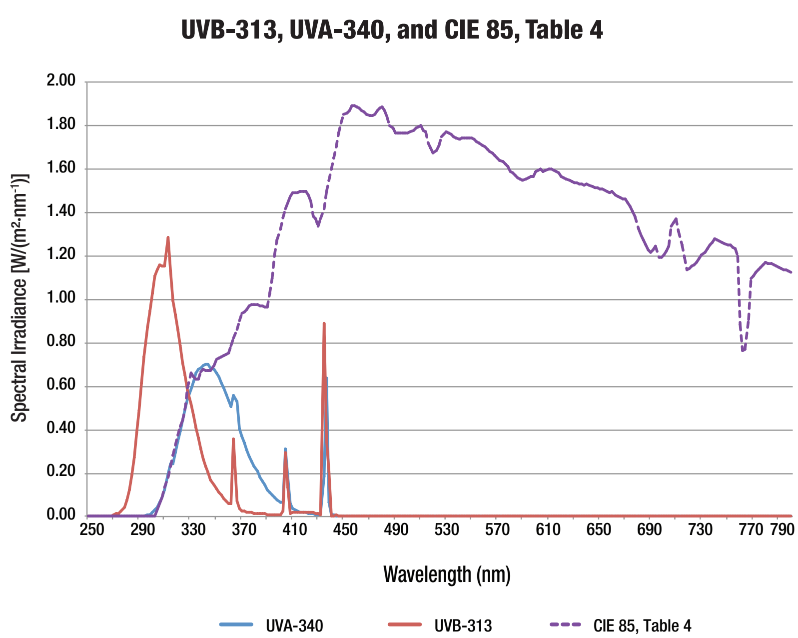


Figure 5. Fluorescent "black light" lamps and CIE 85 reference SPDs. Data normalized at 340 nm.

When comparing these various SPDs to a reference spectrum such as CIE 85 or Miami sunlight, the similar (or dissimilar) curves speak for themselves. But this analysis is quantified in Table 1, with comparisons of the percentage of irradiance at different wavelength ranges with respect to either Total UV (300-400nm) or UV plus Visible Light (300-800 nm). The variation of the different xenon-arc SPDs in Figure 2 may appear quite small and, in fact, all meet the requirements in ISO 4892-2 [8] and ASTM G155 [9] for "Daylight" filter systems. However, it should be stressed that these slight differences can result in significant differences in the type or rate of photolytic changes of exposed materials [10].

SPD and Photodegradation

The specific response of a photosensitive material, and its resulting effect on properties of interest, is dependent on both the specific material chemistry (and its degradation pathways) and the specific light stress applied (the spectral power distribution). Referring to Planck's law as mentioned above, even small differences in the SPD, as evidenced in Table 1, can have a significant impact. For example, some materials, such as polycarbonate, are very sensitive to the cut-on wavelength. For such materials, any deviation from the nominal cut-on of terrestrial solar radiation may skew the degradation, resulting in decreased correlation between the artificial and natural exposure. This disparity in material response can occur even when different xenon lamp and filter combinations comply with the often broad "daylight" spectral requirements of a standard test method as mentioned above.

The total UV portion of sunlight comprises only a small percentage of the total energy as shown in Table 1, yet it is often responsible for the bulk of photodegradation. Although the spectral irradiance levels of the low wavelength UV appear small, be aware that seemingly similar SPD's may actually vary substantially in the irradiance at critical low wavelengths. Therefore, getting the "right light" through improved lamp and filter technology is a major target for improving test correlation, even though test standards often resist adopting the latest improvements in order to remain historically "backwards compatible."

Useful Radiometric Terms

Although photometric units such as lux (lx) are often used to quantify light detectable by and skewed to the response of the human eye, radiometric measurements provide International System of Units (SI) measurements over the entire electromagnetic spectrum and are universally used in weathering and most lightfastness and photostability studies. As the terminology and unit relationships are often confusing to those inexperienced in weathering, a brief review is useful.

- **Irradiance** is the incident radiant flux over a given area (or, simply, the light falling on a specific area of a surface), typically expressed in units of watts per square meter (W/m^2).
- **Spectral irradiance** is the irradiance of a surface per unit of wavelength, commonly expressed in watts per square meter per nanometer ($W/m^2 \cdot nm^{-1}$).
- **Radiant exposure** or **irradiation** is the radiant energy incident over a specific area integrated over time, or "dosage." Units are (W/m^2) • time (seconds, s) which is $(W \bullet s)/m^2$. Since, by definition, 1 Joule (J) = 1 W•s, substituting J for W•s results in:

  Radiant exposure dose (J/m^2) = Irradiance (W/m^2) • Time (s)

It is typical to express narrow band (e.g., 340 nm, 420 nm) radiant energy dosages in "kiloJoules" (actually kJ/m^2); broadband (e.g., 295-385 nm, 300-400 nm) and wideband (e.g., 300-800 nm, 295-2500 nm) values in "MegaJoules" (properly MJ/m^2); and exposure periods in hours (h) rather than in seconds. Therefore, we can substitute h • 3600 s/h = seconds in the above equation, resulting in:

$$J/m^2 = W/m^2 \bullet 3600 \bullet (s/h)$$

To convert to "kilojoules," for example, divide both sides by 1000, yielding the familiar equation:

$$kJ/m^2 = W/m^2 \bullet 3.6 \bullet h$$

For the sake of convenience, units of irradiance and radiant energy are frequently (but incorrectly) written in "shorthand notation" as *per* m^2 rather than the technically correct per ($m^2 \bullet nm^{-1}$). However, in all cases the wavelength (or wavelength range) must always be specified for either the irradiance or the radiant energy values to have any meaning. A "kilojoule" of 340 nm radiation is not the same as a "kilojoule" of 300-400 nm radiation, and costly mistakes result when this is overlooked. Also, wavelengths cannot be mixed in the formulas for them to be valid. Finally, when calculating test end time from the irradiance and radiant energy values, if the test method contains any "dark time" periods, they must be factored into the total test time.

Light Not Only Weathering Factor

When trying to answer "How many hours in a weathering instrument is the equivalent of one year of exposure in Miami (or other locale)?" we often start by comparing the instrument time it takes to deliver an equal amount of simulated solar radiation — e.g., Total Ultraviolet Radiation (TUVR) — as a one-year Miami exposure. Even if we are able to accomplish it, this is not "correlation," but rather only an "equivalent" UV dose. (Note: The term "equivalent" is purposely put in quotations to indicate that it really may not be equivalent at all in terms of actual degradation mechanisms/rates due to the difference in SPD, spectral cut-on, etc. as explained above. Therefore, in material weathering, a number of caveats apply — see ISO 4892-1 and ASTM

Continued on next page

Light, Weathering and the Numbers Game, from previous page

G151.) For one or more of the following reasons, a guarantee that identical specimens receiving the same total radiant exposure from different sources, or repeated exposure from the same source, will exhibit identical changes in properties should never be issued:

1. **Materials are selectively sensitive to the wavelength distribution of energy.** A specific material may behave differently when exposed to sources that have different spectral power distribution, as shown in the previous spectral power distribution graphs.
2. **Photochemical reactions can be temperature sensitive.** Alternatively, photons may initiate photodegradation, but there are often thermally driven secondary reactions such as oxidation and free radical reactions (the autocatalytic photo-oxidation cycle) that continue and often result in the majority of damage. The temperatures materials experience on exposure to natural conditions are dependent on nature, and will vary hourly, daily, and seasonally. Most laboratory exposures define a specific temperature for black panel (BPT or BST) or chamber temperature (CHT), with a tolerance of just a few degrees. Because of this, rates of degradation may differ between the two exposures.
3. **The effect of moisture (in any phase) may cause physical or chemical degradation during exposure.** The moisture delivery in a laboratory exposure may simulate natural conditions very well, but the duration of condensation, the frequency of wetting, changes in humidity, and exposure to pollutants such as acid rain must be considered as additional variables in the weathering processes of natural and laboratory exposure tests. And specimen temperature also affects moisture. Degradation can proceed by reactions with water alone (hydrolysis), or synergistically with light and heat.

Spectral Comparison of Various Radiation Sources Used for Outdoor Test Conditions

		% Irradiance vs. Total UV (300-400 nm)						% Irradiance vs. UV + Visible		
	Wavelength Range	$280 < \lambda \le 300$	$300 < \lambda \le 320$	$320 < \lambda \le 340$	$340 < \lambda \le 360$	$360 < \lambda \le 380$	$380 < \lambda \le 400$	$\lambda < 300$	$300 \le \lambda \le 400$	$400 \le \lambda \le 800$
Radiation Source	Reference/Filter System/Bulb Type									
Reference Spectrum	CIE 85, Table 4	0.00	5.0	16.9	20.6	26.4	31.1	0.00	9.9	90.1
Xenon-arc	Peak Miami Sunlight	0.10	6.3	18.0	21.3	26.7	27.7	0.006	9.3	90.6
	Right Light/Quartz	0.05	4.8	16.3	22.5	26.1	30.3	0.003	11.2	88.8
	Type S/Type S	0.48	4.8	13.3	21.3	27.4	32.8	0.04	10.5	89.4
	Xenochrome 300	0.54	6.0	14.5	21.7	25.7	31.6	0.04	10.2	89.8
	XLS+ Daylight	0.02	3.3	13.2	21.9	28.0	33.6	0.00	10.0	90.0
Metal Halide	MHG	1.25	5.9	9.8	20.8	30.9	31.3	0.11	10.2	89.8
Fluorescent UV	UVA-340	0.20	8.9	30.6	33.7	19.9	15.9	0.10	91.4	8.8
	UVB-313	24.54	45.7	21.2	5.4	2.7	9.5	18.55	73.1	8.3

Spectral Comparison of Various Radiation Sources Used for Indoor Test Conditions

		% Irradiance vs. Total UV (300-400 nm)						% Irradiance vs. UV + Visible		
	Wavelength Range	$280 < \lambda \le 300$	$300 < \lambda \le 320$	$320 < \lambda \le 340$	$340 < \lambda \le 360$	$360 < \lambda \le 380$	$380 < \lambda \le 400$	$\lambda < 300$	$300 \le \lambda \le 400$	$400 \le \lambda \le 800$
Radiation Source	Reference/Filter System/Bulb Type									
Reference Spectrum	Miami Behind Glass	0	0.38	9.7	22.8	32.4	34.7	0	7.89	92.1
Xenon-arc	Type S/Soda Lime	0	1.84	11	22.1	29.4	35.7	0	10.73	89.3
	Xenochrome 320	0	0.78	8.8	22.4	31	37	0	10.63	89.4
	XLS+ Daylight Behind Glass	0	1.24	10.8	22.3	29.8	35.8	0	9.31	90.7

Table 1. Percentage of irradiance as compared to Total UV (300-400nm) or UV + Visible Light (300-800nm) for filter systems used for outdoor test conditions (upper table) and indoor test conditions (lower table)

Modeling and Predicting Weathering Degradation

Efforts to model, and therefore predict, weathering degradation of polymers and coatings has been ongoing for several decades, and slow but steady progress is being made, as evidenced by the research papers and conference presentations over the years. However, the physics equivalent of a "unified field theory" does not yet exist for weathering, and current models are either validated only for specific materials under specific conditions, or limited to a narrow range of particular commercial formulations.

Two fundamental facts make the task of modeling daunting. The first is that commercial polymers, in particular, are generally not very pure materials, and internal defects as well as additives and contaminants can fundamentally affect weathering degradation chemistry. The second regards the natural variability inherent to outdoor exposures. It is confounding that the constantly changing nature of weathering stresses is expected to be adequately simulated by artificial test methods that require control (at steady-state) of those same stresses. It is likely that we will never be able to design weathering tests and the instruments to perform them that completely mimic real weather. And the more we try to accelerate weathering in the laboratory, the more likely we are to negatively skew the natural balance of the key weather stresses of heat, light, and moisture and decrease correlation.

However, by designing-in the best ways of delivering the weathering trilogy stresses, such as better simulation of terrestrial solar radiation, and test parameters such as stress levels and cycles that better mimic actual outdoor conditions, the more likely it is that test results will correlate and be relied upon for weathering qualification tests and service life prediction.

References

[1] M. Roylance, D. Roylance, Ch.14 Forms of Polymer Degradation Overview, Environmental Degradation of Advanced and Traditional Engineering Materials, L. Hihara, R. Adler, R. Latanision editors, CRC Press, 2013.

[2] Š.Chmela, Course 4. Photodegradation of Polymers, Advanced Bio-Friendly Polymers conference, Bratislava, Slovakia, 2013.

[3] CIE Publication 85-1989, Solar Spectral Irradiance, 1989.

[4] ISO 4892-1:2016 Plastics – Methods of exposure to laboratory light sources – Part 1: General Guidance, 2016.

[5] ASTM G151-10 Standard Practicd for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources, 2010.

[6] ISO 4892-3:2016 Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps, 2016.

[7] ASTM G154-12a Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials, 2012.

[8] ISO 4892-2:2013 Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps, 2013.

[9] ASTM G155-13, Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials, 2013.

[10] M. Nichols, Refining Accelerated Weathering Testing to Anticipate Outdoor Exposure Performance, 2010 International Symposium on Natural and Accelerated Weathering, Tokyo, 2010.

TESTING SERVICES ATLAS

Atlas 25+® Testing Program Yields Second-Time Success for First Solar

Atlas is pleased to announce that, for a second time, First Solar, Inc. has completed the rigorous Atlas 25+® Comprehensive PV Durability Testing program and received test result certification from Atlas' partner SGS, the world's leading inspection, verification, testing, and certification company.

Testing was conducted on First Solar's original Series 4 thin film photovoltaic module, which utilizes the core technology featured in all of the company's product offerings.

The Atlas 25+ protocol is a proprietary, multi-dimensional durability test program designed to subject photovoltaic modules to the environmental degradation stresses that can be expected over long-term service. It provides manufacturers with the data they need to demonstrate long-term durability and to support warranty and performance claims — while also reducing the costs associated with aftermarket product failure.

ATLAS 25+ Comprehensive PV Durability Testing

The Atlas 25+ program exposes solar panels to a series of stresses, including UV-A/UV-B exposure, salt spray corrosion, condensing humidity, solar/thermal humidity cycle, solar/thermal humidity freeze cycle, Arizona and Florida solar tracking — including peak summer — and initial, final, and multiple interval measurements. In order to receive SGS certification, modules are required to have less than 8% degradation over the testing period.

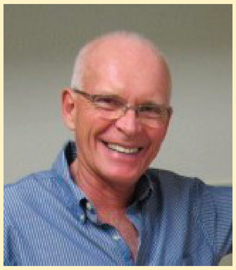
"As part of the Atlas 25+ independent testing program, solar panels are exposed to harsh weather conditions similar to those faced during their lifetime," said Richard Slomko, Director of Atlas' Weathering Services Group. "This is a tremendous achievement for First Solar to complete our Atlas 25+ program again with impressive results. We are extremely pleased that the world's leading thin-film PV manufacturer continues to utilize our unique PV durability testing program to confirm module suitability for long-term operation in the world's harshest climates."

"Only the strong survive in the highly competitive PV technology environment," said Lou Trippel, First Solar's Senior Director of Product Management. "Only a handful of PV manufacturers — and no other thin film manufacturer — have been certified. We are taking the world-class reliability documented here and building it into successive products. We believe product evolution depends on fundamental reliability."

For more information on the Atlas 25+ testing program, contact Chelsea Todd at +1-623-465-7356 x103 or chelsea.todd@ametek.com.

Atlas Quality Manager Retires

Atlas congratulates John Wonders on his retirement, effective July 8, 2016. John has been a part of the Atlas family for over 20 years. He has held numerous positions — from operations to sales to quality — most recently serving as AWSG Quality Manager and Sales Support. John was a favorite among AWSG clients and the main reason AWSG's quality was second to none. We wish John well in all his future endeavors.



Lorenzo Tyler has taken over John's responsibilities as Quality Manager. Lorenzo is located at our Miami, FL location and can be reached at lorenzo.tyler@ametek.com or +1-305-245-3659 x114. For sales support, please contact Chelsea Todd at our Phoenix, AZ site at chelsea.todd@ametek.com or +1-623-465-7356 x103.

Atlas Expands UA-EMMAQUA® and UAWS Devices

Atlas has always been the leader in the outdoor accelerated weathering field, and with the introduction of our Ultra Accelerated-EMMAQUA (UA-EMMAQUA) and Ultra-Accelerated Weathering System (UAWS) devices, the gap has widened.

Due to their popularity, we have increased the number of these devices in our Phoenix, AZ exposure field to better serve our customers. We are proud to announce the addition of 9 new UA-EMMAQUA devices, bringing the total to 33. We have also added another UAWS unit for a total of 3.

Both the UA-EMMAQUA and UAWS utilize our new "cool mirror" technology that boasts high reflectance in the UV and near visible wavelength portions of the solar spectrum and high attenuation in the longer wavelength visible and IR ranges. As the name "cool mirror" suggests, cooler sample temperatures are one of the biggest benefits of testing on these devices. Using state-of-the-art technology, these mirrors allow samples to be exposed to ultra-high levels of irradiance without being heated to extreme temperatures.

Atlas Ultra-Accelerated Weathering System

Why would cooler sample temperatures be beneficial for test results?

Accelerated weathering equipment designed to expose samples to ultra-high levels of irradiance often overheats test samples, causing unnatural degradation that may never be seen or experienced in a material's end-use environment. Our Ultra-Accelerated devices are unique in that they satisfy three crucial requirements for ultra-accelerated exposure testing:

- Allows for the exposure of many different types of materials to ultra-high UV irradiances
- Maintains high fidelity to the natural solar UV spectrum
- Keeps specimens at acceptable exposure temperatures

Atlas' new UA-EMMAQUA device is fully compliant with current industry standards, such as ASTM G90-10: Standard Practice for Performing Accelerated Outdoor Weathering of Nonmetallic Materials Using Concentrated Natural Sunlight and is capable of performing any cycle listed in the standard.

Atlas Ultra-Accelerated EMMAQUA

Materials that require a long service life, transparent and glazing materials, temperature-sensitive materials such as PVC, coatings applied to metal panels, and materials that perform well in EMMA or EMMAQUA testing are ideal candidates for this new ultra-accelerated exposure testing.

If you have questions about UA-EMMAQUA or UAWS testing or to obtain a quote, contact your local representative or Chelsea Todd: chelsea.todd@ametek.com, +1-623-465-7356 x103.

ATLAS • STANDARDS • NEWS

Atlas Hosts ISO TC42 Standards Meeting

In June 2016, Atlas hosted an international group of industry experts during the summer ISO TC42/WG-5 meetings for physical properties and image permanence of photographic materials at our Linsengericht, Germany location.

Two task group meetings (TG2 and TG3) were held, discussing a wide range of topics, including the specification for photo books, a technical report on the comparison of image degradation between accelerated weathering test methods and outdoor exposure, and methods for indoor light and ozone testing. Meetings were also held for the WG-3 and WG-8 groups of TC42. Attendees enjoyed a city tour of historical Gelnhausen, Germany.

Committee members came from six different countries, representing academic institutions, testing companies, secure identity solution providers, image and print generation businesses, and test instrument manufacturers Atlas and Suga Test Instruments. The meetings coincided with the 2016 DRUPA Print Media Fair that began earlier in the month in Düsseldorf.

ISO TC42/WG5 members break from meetings to pose for a picture and enjoy the sunny summer weather.

The group meets biannually; Ryerson University in Toronto, Canada, will host the meeting in November 2016. Atlas has participated in the group for more than 15 years.

ATLAS • ONLINE

Atlas Weathering Consulting Insights Available Online

Drawing on decades of weathering leadership and expertise, the Atlas Consulting Group provides in-depth consulting services that assist clients in developing and applying the best weathering test methods and strategies for their products.

Through its Atlas Weathering Consulting Insights newsletter, the group offers insights and information on a variety of topics related to long-term durability testing and shares helpful real-world examples.

Sent to subscribers four times a year, the newsletter is now available on demand through the Atlas website at **http://atlasmtt.com/wci**. You may search and download PDFs from a comprehensive archive of past issues of the newsletter, as well as subscribe to automatically receive future issues via email.

Czech Workshop Draws Over 100 from Range of Industries

In June 2016, Atlas' representative in the Czech Republic, KAITRADE, hosted an annual technical workshop, "Trends in Simulation of Environmental Influences." This two-day event was part of a series of seminars that began over 16 years ago, originally developed to bring companies and clients in the automotive industry together to discuss new innovations.

As this longstanding seminar has evolved over the years, so has its focus. Not only do various companies that KAITRADE represents present their products, but now the program includes participation from attendees who are given the forum to present their company's product and service offerings to a wider audience.

Speakers this spring included Dirk Oefner, Atlas' EMEA Sales Director, who talked about the new ASTM D7869 standard, and Michal Kalik, Atlas' Eastern European Regional Sales Manager, who spoke about the Volkswagen company standard VW PV1303 and its impact on testing procedures.

More than 100 participants came from an array of industries, including automotive, paints and cosmetics to commercial testing institutes and universities.

Feedback was overwhelmingly positive. Attendees were pleased with the high quality of the presentations and the organization of the event, which allowed presenters and guests the opportunity to exchange ideas during the workshop as well as at social activities.

Stay tuned for information about the next Czech workshop, tentatively planned for the second quarter of 2017!

Follow Atlas on LinkedIn

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Find us at AMETEK Atlas Material Testing Technology:
https://www.linkedin.com/company/ametek-atlas-material-testing-technology

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