Material Testing Product and Technology News

Volume 46
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SunSpots®

Spring 2016

Atlas Assumes Sub-Tropical Testing Service's Outdoor Weathering Business (page 13)

How Weathering Tests on Properly Designed "Coupons" Can Increase the Service Life of Photovoltaic Modules

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Introduction

With over 200 gigawatts of capacity installed worldwide in 2015, solar photovoltaic (PV) now accounts for 1% of global electricity production. In Europe, solar PV already makes up more than 3.5% of electricity generation. And the trend is growing quickly, with 540 gigawatts of capacity expected to be installed worldwide by 2020.

Despite this growth, little attention has been paid, in the certification process of PV modules, to weathering stability. This is surprising, as PV modules comprise polymeric films such as EVA encapsulants and polymer-based backsheets. The weathering stability of such polymeric material is limited by nature, and its degradation will inhibit PV module production at some stage. Acceleration of polymer degradation by cell metallization, ribbons, and interactions between polymers needs to be analyzed.

As the use of solar PV further expands in the Sun Belt region of the U.S., weathering stability will become more and more crucial.

To achieve the desired durability, polymeric films, especially polyolefin-based like EVA, are generally stabilized by antioxidants, UV absorbers, light stabilizers and, if required, metal deactivators. The correct design and optimization of the formulation of such a material requires testing procedures that simulate real life as closely as possible. Not only should the material be exposed to a representative combination of stresses (sunlight, heat, humidity, thermal shocks), but it should also be done within a representative assembly of a PV module.

However, weathering with the actual assembly is difficult because PV modules are large, complex structures, and because a UV dose corresponding to at least 25 years outdoor exposure should be applied. Even at 2-Suns (double than usual irradiance) conditions, this would require more than 1 year of weathering. In fact, our experience with roofing membrane material shows that 12,000 hours are typically required.

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	September 20–21, 2016	Linsengericht, Germany	Presented in English
	October 4, 2016	Mount Prospect, IL, USA	Presented in English
Xenotest® Workshop			
	September 13–14, 2016	Linsengericht, Germany	Presented in German

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Atlas Welcomes New UK/Ireland Sales Manager

Atlas is pleased to announce Rikesh Tailor as the new National Sales Manager for UK and Ireland. Rikesh joined the Atlas team in November 2015.

Rikesh has a BSc (Hons) in Biomedical Science and brings with him an impressive 10-year history in the scientific, sales, and service industries. During his career, he has provided solutions to a wide range of markets including automotive, paints and coatings, pharmaceutical, food and beverage, and laboratory.

Rikesh looks forward to introducing himself to Atlas' customers, becoming familiar with their businesses, and working with them to successfully meet all of their weathering testing needs.

Feel free to reach out to Rikesh anytime with questions: +44(0)7920064101 or rikesh.tailor@ametek.com.

CHINAPLAS 2016
April 25–28, 2016
Shanghai, China
Booth #W1 H71, Hall W1

JSAE Automotive Engineering Exposition 2016
June 29–July 1, 2016
Nagoya, Japan
Booth #165

Asia Pacific Coatings Show
September 21–23, 2016
Bangkok, Thailand
Booth #D35

Automotive Testing Expo China
September 27–29, 2016
Shanghai, China
Booth #3012

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

ITMA China
October 21–25, 2016
Shanghai, China

Automotive Testing Expo USA
October 25–27, 2016
Novi, MI, USA
Booth #2023

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

ChinaCoat
November 30–December 2, 2016
Guangzhou, China

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/

Polymer Testing & Analysis 2016
April 14, 2016
Maritim Hotel
Cologne, Germany

"Measurement and Evaluation of the Specimen Surface Temperature in Artificial Weathering"

Presenter: Dr. Florian Feil, Atlas Material Testing Technology GmbH

Centre National d'Evaluation de Photoprotection (CNEP) Ultra-Acceleration Seminar
June 16, 2016
CNEP
Aubiere Cedex, France

"High Irradiance Xenon Arc Weathering – Capabilities, Utility and Limitations"

Presenter: Kurt Scott, Atlas Material Testing Technology LLC

"Accelerated Weathering of Polymeric Materials – New Technologies Driving Faster More Accurate Results"

Presenter: Scott Zimmerman, Atlas Material Testing Technology LLC

Profiles 2016
June 28, 2016
Hilton Philadelphia City Avenue Hotel
Philadelphia, PA, USA

"Accelerated Weathering of Vinyl and Composites – New Technologies Driving Faster, More Accurate Results"

Presenters: Scott Zimmerman and Matthew McGreer, Atlas Material Testing Technology LLC

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Weathering Tests on "Coupons," from page 1

To overcome these challenges, the industry's approach has been to use convenient and available resources — primarily, the so-called 1,000 hours Damp Heat test — to assess and qualify materials. In such a climatic test, PV modules are "aged" 1,000 hours at 85°C at 85% Relative Humidity. Much attention is then usually paid to discoloration (yellowing) of the polymeric films within the PV modules. But let's be honest, developing optimized polymeric films for PV modules with "dark" Damp Heat conditions makes no more sense than studying photosynthesis without taking light into account!

In this article, we will show how a 2-Suns weathering test performed on coupons (small, representative assemblies of "Glass/EVA (encapsulant)/Glass" or "Glass/EVA/Cell + Ribbon/Backsheet") provides useful results that mimic the degradation of PV modules observed in the field. We will discuss the importance of correctly designing the coupons — e.g., their size — to take into account oxygen diffusion processes and subsequent bleaching effects. We will also report on the observed variability in EVA weathering stability and the need for further work on this topic in collaboration with cells and modules producers. We will also show that Damp Heat testing leads to unrealistic discoloration reactions and is counterproductive in the quest for optimized polyolefin- and polyamide-based formulations (encapsulant and backsheet) for PV applications.

2-Suns Weathering Test

To correctly develop products for demanding outdoor applications, Renolit N.V. uses a Ci5000 Weather-Ometer® in 2-Suns conditions, i.e., with an irradiance of 1 $W/m^2 \cdot nm$ at 340 nm. The Xenon lamps are filtered to match the sun spectrum (UV-visible region) with Borosilicate "S" filters inside and outside the construction of the lamps. The Black Standard Temperature is set at 88°C while the Room Temperature is set at 45°C. Demineralized water is sprayed for 18 minutes every 2 hours, creating a thermal shock on the samples during the simulated rain period. The Relative Humidity is set at 40% outside the simulated rain period.

Such a procedure has been used to successfully develop and qualify TPO roofing membranes for 25 years outdoor application on the basis of 12,000 hours resistance of the membranes to cracking and excessive discoloration.

In this article, "2-Suns weathering test" refers to this procedure.

Development of the Coupons

As a specialist in plastic films for industrial outdoor applications, Renolit N.V. develops a multi-layer backsheet produced by co-extrusion. The backsheet is comprised of layers of formulated polyethylene (PE), polyamide (PA), and polypropylene (PP). As with EVA and POE encapsulants, the polymers of a PE/PA/PP backsheet need stabilizers for optimal processing and durability (thermal and UV). Each layer fulfills a specific role. The PE layer enables optimal adhesion of the backsheet to the encapsulation film (EVA, POE, TPO) and protects the PA layer from UV degradation. The PA layer secures the adhesion between the PP and PE layers, improves mechanical and barrier properties, and, together with the PP layer, brings form stability and reliable electrical insulation.

To develop a durable backsheet, it is necessary to check for possible premature degradation due to negative interactions with the metals (ribbons, cells) and/or with the encapsulants of the PV module. Furthermore, the backsheet should not be the limiting factor of assembly durability.

Therefore, we performed weathering tests on coupons of "Glass/Encapsulant (several sources/types)/Cell + Ribbon/Encapsulant/Backsheet" as well as on coupons of "Glass/Encapsulant/Glass" and "ETFE/Encapsulant/ETFE."

Yellowing of PV Modules and Coupons in Damp Heat and in Weathering Tests

Unrealistic discoloration (yellowing) of coupons with the following structure (Glass/EVA/Cell + Ribbon/EVA/PE-PP Backsheet), tested in Damp Heat, has recently been reported [1]. Figure 1 shows discoloration of such a coupon after 1,000 hours Damp Heat and after extensive weathering (21,000 hours!) in a Ci5000 Weather-Ometer® operating in harsh 2-Suns conditions (i.e., the 2-Suns weathering test).

After 1,000 hours of Damp Heat, the coupon shows a severe yellowing (ΔYi of 23), while after extensive realistic weathering conditions, the coupon remains unchanged (slight bleaching, ΔYi of -1).

As reported [1], the discoloration in the Damp Heat test results from the addition of stabilizers — phenolic anti-oxidants, in particular — to the polymers (PP, PE) of the backsheet. Such anti-oxidants are required to improve process and thermal stability. They also play a role during Damp Heat by reacting with remaining peroxides migrating from the EVA to the backsheet. The phenolic moeity of the anti-oxidant is therefore oxidized, and by-products combine to form strongly yellow dyes (with a structure similar to stilbene quinones – Figure 2, left) [2]. When the sample is submitted to realistic conditions (sunlight), the oxidized yellow dye is reduced and reverts to its phenolic anti-oxidant form (not colored).

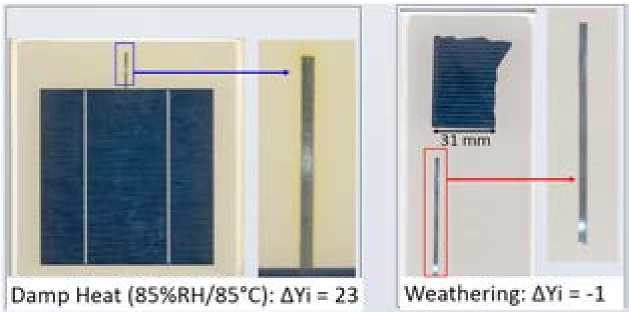

Figure 1. *Left: 1,000 hours DHT (severe yellowing/ discoloration, especially along ribbon); Right: 21,000 hours weathered coupon (no discoloration or corrosion of either fingers or ribbon)*

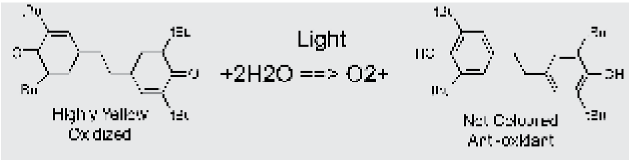

Figure 2

It is important to realize that, without the addition of an anti-oxidant, very minor yellowing is observed on "Glass/EVA/PP-PE Backsheet" coupons after 1,000 hours of Damp Heat. But the PP-PE backsheet will obviously crack prematurely in use, as a result of thermal degradation. Yellowing in Damp Heat is evidence of the addition of effective stabilizers, and its avoidance therefore cannot be a criterion in the selection of appropriate polymeric films for PV modules.

Figure 3. *Discoloration in Damp Heat of a "Glass/EVA/PE-PA-PP Backsheet" coupon, where the backsheet comprises an efficient anti-oxidant with an isocyanurate ring structure. Top: EVA without TAIC; Bottom: EVA with TAIC.*

Another example is as follows: To achieve exceptional processing and long-term stabilization for polyamides and polyolefins, phenolic anti-oxidants with an isocyanurate ring structure (see [2] – AO-5) are well known. Unfortunately, such anti-oxidants share the same isocyanurate ring structure as TAIC (Triallyl Isocyanurate), a common cross-linker of EVA encapsulant. During module processing and Damp Heat, TAIC will migrate and support the oxidation process of the anti-oxidant, producing extremely yellow dyes. As can be seen in Figure 3, bottom, a bright yellow color (reversible under sunlight) develops on the coupon after only one week of Damp Heat testing. This color is not observed when an EVA without TAIC is used (Figure 3, top) — or in reality as the yellow dye reverts under sunlight to a reduced anti-oxidant phenolic form (not colored).

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Weathering Tests on "Coupons," from previous page

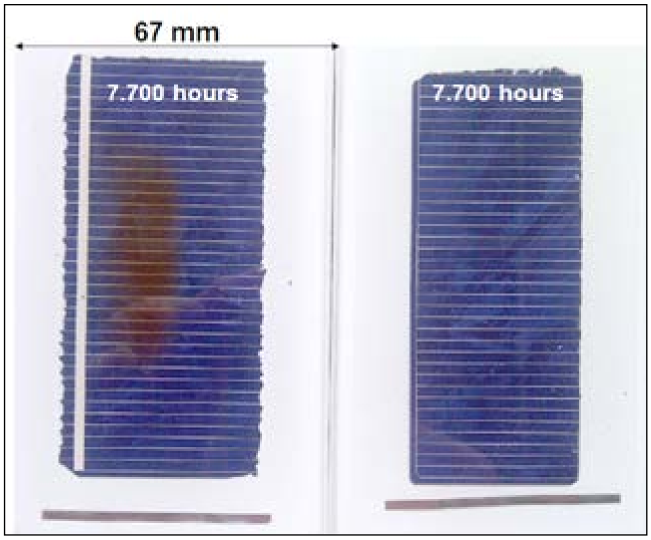

Figure 4. *7,700 hours 2-Suns weathering of 2 coupons of "Glass/EVA/Cell + Ribbon/Rear Encapsulant/PE-PA-PP Backsheet" with same EVA. Left: Development of a brown area between glass and cell at the center (O_2 depletion); Right: No development of such a brown area.*

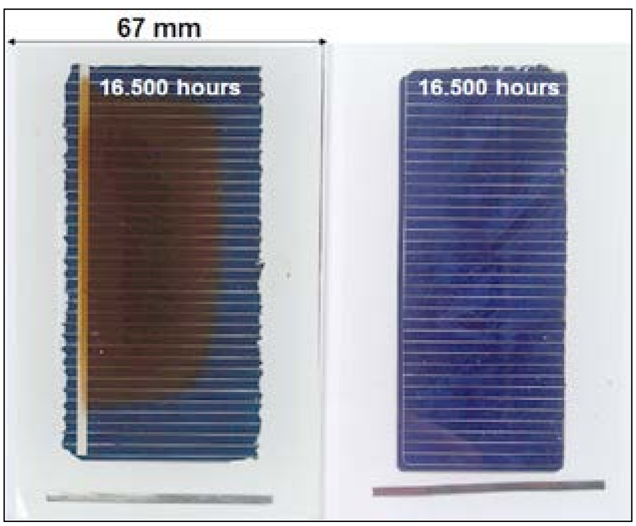

Figure 5. *16,500 hours 2-Suns Weathering of 2 coupons of "Glass/EVA/Cell + Ribbon/Rear Encapsulant/PE-PA-PP Backsheet" with same EVA. Left: Development of a brown area between glass and cell at the center (O_2 depletion); Right: No development of such a brown area.*

Weathering of Glass/ Glass and Glass/Backsheet Coupons

To understand limiting factors of durability of PV module assemblies, we conducted several 2-Suns weathering tests on coupons comprised of different encapsulants in a "Glass/Glass" construction and in a "Glass/PE-PA-PP Backsheet" construction.

The limiting factor of durability turned out to be the encapsulant film (EVA in general) and not the PE-PA-PP backsheet. We noticed surprising variations in encapsulant durability, which requires further work to define the root causes of variations. The results presented here are open for discussion with interested parties.

Figures 4 and 5 show coupons of "Glass/EVA/Cell + Ribbon/ Encapsulant/Backsheet" after 7,700 and 16,500 hours of 2-Suns weathering test, respectively. Although *the same* EVA was used as the front encapsulant, the first coupon (left) showed an onset of degradation of the front EVA after about 6,000 hours of weathering. The degradation starts close to the center of the sample and extends during aging. At the edges of the sample, no visual degradation occurs, even after 16,500 hours. The area of degradation is slightly asymmetrical towards the buss bar.

Surprisingly, the front EVA (from the same roll!) of the second coupon (Figures 4 and 5, right) remained visually unchanged after 7,700 hours and even after 16,500 hours.

Obviously, the size of the piece of cell within the coupon matters, as bleaching occurs at the edges of the coupon — typically 2 cm distance from the edge. The discoloration of EVA under sunlight (UV and at least blue light) is explained by the formation of chromophores (conjugated un-saturations). In the presence of enough oxygen, such chromophores are oxidized (bleaching), and browning is avoided or at least very delayed at the edges of the sample.

From Figures 4 and 5, it appears that no EVA browning would have been observed if the size of the cell had been typically less than 4 * 4 cm.

The piece of cell in the coupon on the right is slightly smaller in size and has no buss bar (also a potential cause of slight O_2 depletion). These tiny differences seem to explain a major difference in discoloration during the weathering test. Note that other effects should also be considered, like EVA thickness, backsheet O_2 permeability, and EVA degradation state (e.g., processing/lamination conditions, amount of residual peroxides).

The importance of correctly setting up the coupons could also be seen in other experiments we conducted with several types of encapsulants (EVA- and VLDPE-based). In "Glass/Encapsulant/Glass" coupons, we observed a better weathering resistance of UV transparent EVAs than UV-absorbing EVAs. The better behavior was not confirmed in a "Glass/EVA/Piece of Cell + Ribbon/EVA/Backsheet" coupon, probably because of higher interaction of the transparent EVA formulation with cell metallization and oxygen migration through the backsheet. The behavior of the UV transparent EVA was clearly inferior in a "ETFE/EVA/ETFE" coupon. ETFE is indeed not at all a barrier against oxygen migration and is also totally UV transparent.

In conclusion, it turns out that the EVA formulation and its state of processing degradation influences the distance on which bleaching may occur. O_2 availability and cell metallization are important factors in the degradation processes of EVA formulations, leading to significant differences in durability.

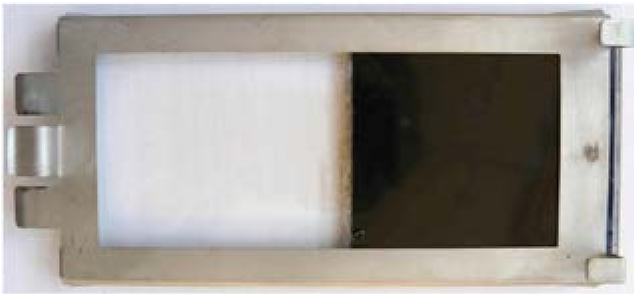

Figure 6. *Picture of the coupon in its holder — left part is "Glass/EVA/Glass" and right part is "Glass/EVA/Glass/EVA/Black Backsheet."*

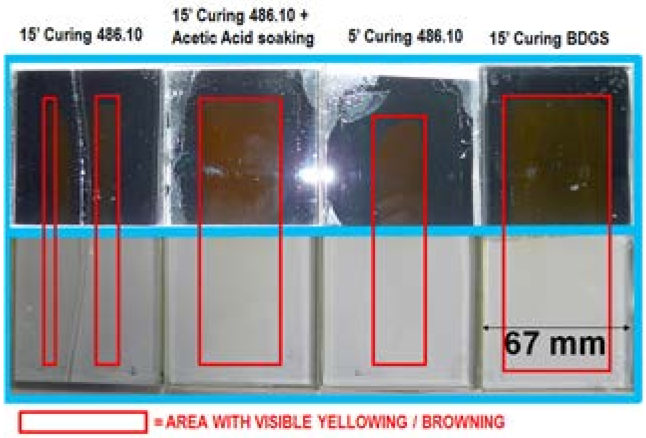

Figure 7. *Picture of "Glass/EVA/Glass" samples after 7,000 hours 2-Suns weathering test. The bleaching distance depends on EVA formulation and its "degradation" state.*

The effect of processing degradation and curing time of a given EVA on the distance of bleaching has been confirmed in a glass/glass assembly, where the half of the sample was a transparent glass/EVA/glass assembly and the other half was equipped with a supplementary black backsheet (Figure 6).

Such a modification was meant to increase sample weathering temperature, from 50°C for the transparent part of the sample to 78°C for the black part of the sample.

Figure 7 shows a view of "Glass/EVA/Glass" coupons after 7,000 hours of 2-Suns weathering test. It is clear that the "Glass/EVA/Glass" coupon comprised of EVA 486, cured 5 minutes at 145°C (Figure 7, second from right) shows a bigger bleaching distance than the one comprised of EVA 486 and cured 15 minutes at 145°C (Figure 7, left).

The effect of an acetic acid soaking prior to lamination is also clear. As with an increase in curing time, this leads to a reduction in the bleaching distance (Figure 7, second from left).

Another EVA formulation leads to a different bleaching distance, while the discoloration at the center of the sample is less pronounced (Figure 7, right).

This experiment shows that processing degradation may influence the durability of the EVA within the PV modules. It confirms the importance of a sufficient quantity of O_2 impermeable

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Weathering Tests on "Coupons," from previous page

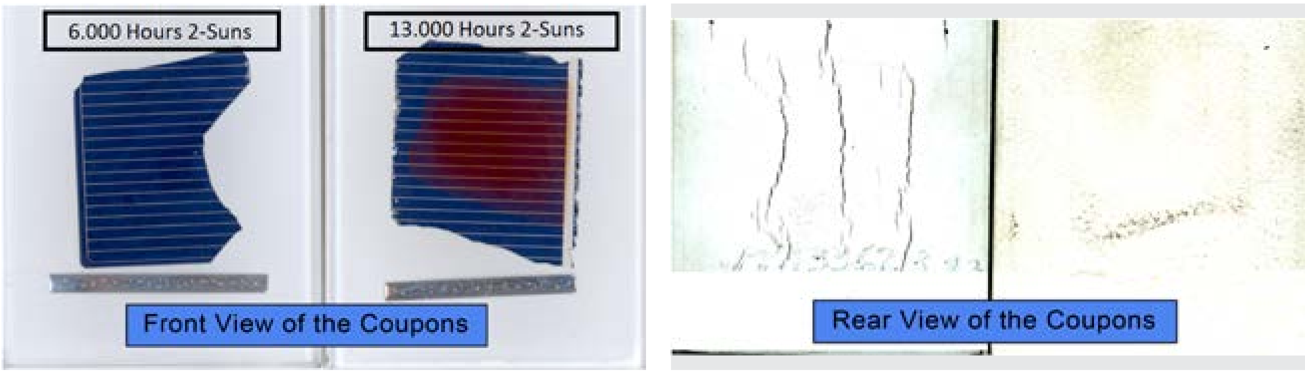

Figure 8. *Picture of the front view and the rear view of 2 different coupons of "Glass/EVA/Piece of Cell + Ribbon/EVA/Backsheet" after 6,000 hours (left) and 13,000 hours (right) 2-Suns. The rear view of the coupons shows a backsheet of poor design which is cracking in the area of the piece of PV cell because of thermal aging degradation and thermal shock (rain cycles).*

layers within coupons, i.e., the size of a piece of cell. 4 cm is a minimum to avoid overall bleaching. In such cases, the effective durability of the encapsulant within a PV module may be largely overestimated.

Figure 8 shows another interesting picture of results observed during our experiments in the 2-Suns weathering test. The coupon on the left is equipped with a poor design of a backsheet. This backsheet cracks after 6,000 hours of aging, mainly because of thermal degradation combined with thermal shocks (by the rain sprays). At the level of the cell, the backsheet reaches a temperature of 75°C.

The better-formulated backsheet (Figure 8, rear view, right) doesn't suffer from cracking after more than 13,000 hours, while the EVA is browning (Figure 8, front view, right).

Conclusion and Recommendations

In order to correctly develop polymeric films for the PV module industry, weathering testing on representative coupons is compulsory. Following are key factors to bear in mind:

- Coupons should be of adequate size to take into account oxygen migration effects (bleaching).
- The encapsulant should also be weathered in contact with a piece of cell, as the metallization may trigger degradation.
- The minimum test duration (2-Suns weathering test) turns out to be at least 6,000 hours. We recommend 12,000 hours.

References

[1] François Rummens, "Long-term accelerated weathering tests on 'coupons' to develop new classes of backsheets," EU PV SEC, Hamburg, 2015

[2] Ivan Vulic, Giacomo Vitarelli, John M. Zenner, "Structure-property relationships: phenolic antioxidants with high efficiency and low color contribution," Polymer Degradation and Stability 78 (2002) 27–34

Ci35/65 Weather-Ometers Now Obsolete; Upgrades Recommended to Avoid Downtime

In October 2014, Atlas notified customers of a December 2015 obsolescence date for our Ci35/65 series carbon-arc and xenon-arc Weather-Ometers (including the "A" series). This was the latest notification in our product obsolescence plan, initially communicated in 2007.

Now that the Ci35/65 series Weather-Ometers are formally obsolete, we want to share information with you on these legacy instruments. Due to lack of availability of various parts and components, we are challenged in continuing to provide you with the same high level of support you expect for your fleet of Atlas weathering instruments. Over the coming months, parts availability will continue to decline. We will continue to support these units to the best of our ability, providing general preventive maintenance and calibration services, as well as consumables such as lamps and filters, for the foreseeable future. However, the price and availability of items for this generation of instruments can no longer be guaranteed.

With fewer Ci35/65 instruments now in use, repair parts are less available and the cost of specialized repair parts has increased. Consequently, we are no longer able to offer any discounts that you may currently be receiving under service contracts or as part of our popular AMECARE program for service of these instruments.

We appreciate your understanding and cooperation in managing these instrument obsolescence challenges. To avoid any downtime that is sure to result from a lack of parts, we urge you to consider upgrading your laboratory with current generation Atlas instruments.

Please contact your Atlas sales representative to learn more about our latest Ci Series Weather-Ometers and how they can benefit your testing program.

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The Value of Optical Properties Measurements in Product Development

Transmittance, reflectance, absorptance, and thermal emittance are four categories of optical properties that can prove immensely helpful in the development cycle of a material across a wide variety of industries. Knowing how each wavelength range of the solar spectrum, namely the UV, visible, and infrared regions of sunlight, interacts with materials is critical to the functionality of many products. The information generated from these measurements can be used to determine everything from the wavelengths at which photodynamic therapies will activate inside the human body for the pharmaceutical industry to the amount of solar irradiance that will pass through solar selective films for those that produce thin films for architectural glass, PV modules, and other applications.

New applications for optical properties measurements are being discovered all the time in both established as well as budding new industries, but what exactly are optical properties measurements?

Figure 1: The Perkin Elmer Lambda 950 spectrophotometer is used to perform spectral transmittance, reflectance, and absorptance measurements.

In order to understand optical properties measurements, one must first know what the field of optics entails. Optics is defined as “The branch of physics that deals with light and vision, chiefly the generation, propagation, and detection of electromagnetic radiation having wavelengths greater than x-rays and shorter than microwaves”[1] or “The scientific study of sight and the behavior of light, or the properties of transmission and deflection of other forms of radiation”[2]. Essentially, optics is a field of study within physics that examines how light interacts with various materials in our environment and the subsequent results of that interaction.

In the Optics Lab at Atlas Weathering Services Group (AWSG), we perform transmittance, reflectance, and absorptance measurements in accordance with ASTM E903 *Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres* using a top-of-the-line Perkin Elmer Lambda 950 with a Spectralon®-coated, 150-mm integrating sphere (Figure 1) and a Gier-Dunkle DB-100 Infrared Reflectometer (Figure 2) for thermal emittance measurements performed in accordance with ASTM E408 *Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.*

Currently, there are many standards that define what the optical properties of specific materials should be based on, and accepted parameters within a given industry. The majority of these standards refer back to ASTM E903 and ASTM E408 for the specific procedure on how to perform these measurements to obtain accurate data. That is why these two standards are referenced on all test reports coming from an AWSG lab.

In addition to the two main governing standards for optical properties measurements, a myriad of industry-specific documents cover the details unique to materials produced in various industries. Industries ranging from agriculture to textiles have been able to capitalize on the information gathered from optical properties measurements to develop new and better consumer products due in part to the fact that these measurements can be performed on pigments, liquids, oils, dyes, pastes, creams, and solids. This has opened the door to a vast array of materials eligible for optical properties testing.

The most frequent requests come from architectural materials manufacturers that need to determine the thermal mitigation properties of the products for which they are seeking Cool Roof Rating Council, LEED, or Energy Star ratings. By determining which wavelengths of light are transmitted, reflected, and absorbed and how much thermal emittance is given off by a specific material, these manufacturers are helping to solve the "urban heat island effect"[3] of metropolitan areas, as well as helping make residential and commercial buildings more energy efficient.

Along the same lines, architectural glass and glazing manufacturers use optical properties measurements to test solar selective coatings for windows that are designed to keep UV and infrared radiation at bay and regulate a building's environment. In turn, HVAC system manufacturers are able to use the data generated by the architectural glass and glazing manufacturers to fine tune their systems to match a specific building type's needs.

Paints and coating manufacturers whose specialty offerings have highly reflective, anti-reflective, blurring, or thermal mitigation functionalities also benefit from knowing the optical properties of their materials. And the solar industry, which relies on solar selective films and glass, uses optical properties data to hone modules to achieve optimal efficiency.

Figure 2: The Gier-Dunkle DB-100 is used to perform thermal emittance measurements.

These are a few of the more established industries and applications that benefit from optical properties measurement, but what about newer industries and applications?

Agrophysical research institutes are using optical properties evaluations to develop new ways of structuring the molecular constituents of food to make them healthier, to make them more stable during transit, and in some instances, to improve their microwaveability. These measurements have also been used to assess the effect of UV light on brown-shelled eggs and to determine the constituents of individual foods (e.g., how much protein, water and fat is in a given sample), allowing researchers to assess the economical viability of the production of certain foods.

Optical lens manufacturers utilize these measurements to fine tune the clarity and depth of focus of lenses and filters used in everything from everyday SLR cameras to state-of-the-art interstellar telescopes.

Pharmaceutical companies use optical properties measurements for researching and developing new medication formulations that interact with sunlight to become active therapies and to maintain the visual consistency of existing medications. In the medical field, the use of blue and white light therapies for acne as well as spider and varicose veins has been successful thanks to preliminary research using optical properties measurements on light quality and how it interacts with human tissue.

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ATLAS TESTING SERVICES

Optical Properties Measurements, from previous page

Telecommunication firms use optical properties to determine the functionality and limitations of new fiber-optic cables that bring us faster Internet speeds and higher-resolution images on our computer screens.

Most recently, AWSG's Optics Lab has added powdered pigment, polymer, and resin manufacturers to the list of industries that request optical properties measurements. The first readings of powdered materials were successfully completed in 2015 for an industry-leading customer. Thanks to the vast array of solid and liquid states that can be measured, highly specialized industries have been able to formulate and refine materials that make our lives healthier, more comfortable, and more secure.

Despite their widespread use, optical properties measurements have by no means reached their limit. New applications are being explored and developed all the time, which speaks to the usefulness of transmittance, reflectance, absorptance, and thermal emittance measurements in the product development cycle. By knowing how certain wavelengths of light interact with a material, scientists the world over have been able to manipulate base materials into everyday consumer products. With seemingly endless uses for optical properties measurements, what will be the next big application? The only way to know for certain is to test those materials and find out.

References

[1] Optics. (n.d.). Retrieved February 22, 2016, from http://www.thefreedictionary.com/optics

[2] Oxford Dictionary of English. (n.d.). Retrieved February 22, 2016, from https://books.google.com/books?id=anecAQAAQBAJ

[3] Heat Island Effect. (n.d.). Retrieved February 22, 2016, from http://www.epa.gov/heat-islands

Atlas Weathering Services Group Complies with ASTM D7990-15 Revision

ASTM D7990-15 *Standard Test Method for Using Reflectance Spectra to Produce an Index of Temperature Rise in Polymeric Siding* has recently been revised. This standard now states that all reflectance measurements used to meet this specification are required to be performed on a spectrophotometer that has a polytetrafluoroethylene (PTFE)-based coating inside of the integrating sphere, as the earlier barium sulfate coatings have been shown to produce unreliable results.

Atlas Weathering Service Group's Perkin Elmer Lambda 950 spectrophotometer has a PTFE-based coating inside its integrating sphere, allowing us to obtain reliable and repeatable data that comply with this new equipment stipulation.

To request a quotation for this service, contact AWSG Sales Specialist Chelsea Todd: chelsea.todd@ametek.com +1-623-465-7356 x103

Atlas Assumes Sub-Tropical Testing Service's Outdoor Weathering Business

Atlas is pleased to announce that as of December 2015, it has taken over all operations of Sub-Tropical Testing Service (STTS) headquartered in Miami, Florida.

STTS is a leader in natural outdoor and accelerated weathering with test sites in Arizona and Florida. The combination of two pioneers in outdoor weathering testing further solidifies Atlas' position as the global leader in weathering testing services.

"Atlas is excited at the opportunity of having those businesses which have worked previously with STTS become new members of Atlas' client family," said Richard Slomko, Director of Atlas Weathering Services Group. "We look forward to providing them access to our broad range of outdoor and accelerated weathering services."

For more than 85 years, Atlas has pioneered materials durability testing, providing clients with guidance and advanced testing solutions to help determine a product's long-term performance and durability with respect to weathering.

For more on Atlas' weathering testing services, visit www.atlasmtt.com/awsg.

Longtime AWSG European GM Retires

Atlas congratulates Siegfried "Siggi" Roessner on his retirement, effective February 29, 2016. Siggi was part of the Atlas family for over 28 years. He held numerous positions within the company and managed Atlas Weathering Services Group (AWSG) operations in Europe as General Manager for most of his tenure.

Siggi's dedication to providing outstanding customer service and quality are the reasons for AWSG's success in Europe. His positive attitude and commitment to teamwork will be missed by his fellow peers. We wish Siggi well in all of his future endeavors.

Andreas Ruth has assumed Siggi's responsibilities as AWSG EU Manager. Andreas is located at Atlas' Linsengericht-Altenhasslau facility and can be reached at andreas.ruth@ametek.de or +49 (0) 6051/707 272.

For questions on testing in our Duisburg, Germany lab, contact Olaf Sucker at olaf.sucker@ametek.de or +49 (0) 2065/7649 0.

New Standards for Estimating Heat Build-up Caused by Solar Radiation

Solar radiation causes the temperature of irradiated surfaces to rise substantially above the temperature of the surrounding air. For many applications, the actual in-service temperature is essential. Material degradation depends on the real temperature stress of the specimens.

For instance, the inside temperature of a house depends on the solar load of the walls and roof outside the house. This influences the climatization measures of the house. If the temperature magnitude is estimated to be critical, provisions can be taken to optimize the in-service micro climate — e.g., reducing the in-service temperature by improving the spectral reflection characteristics or making an appropriate change in design and improving the air conditioning.

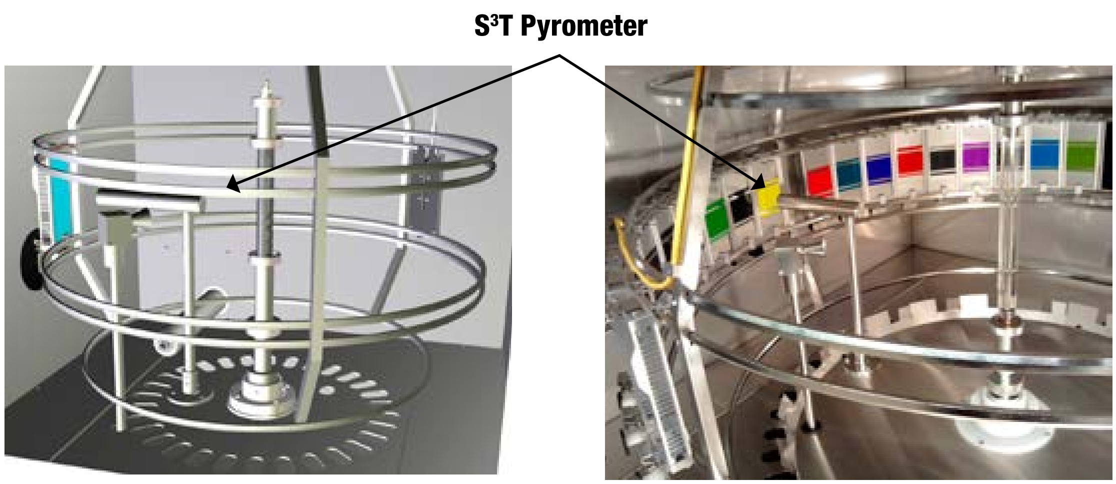

Figure 1: Pyrometer in a weathering instrument used to measure the surface temperature of the exposed samples. The temperature is recorded while the samples rotate past the pyrometer.

Currently, there are two standards that specify methods for estimating the temperature increase of a flat polymer surface due to its solar radiant energy absorption compared to its ambient temperature: European standard EN 16795:2015 (Plastics. Method for Estimating Heat Build-Up of Flat Surfaces by Simulated Solar Radiation) and German Automobile Association standard VDA 230-215: 2015 (Leather, Synthetic Fabrics and Textiles for Automobiles, Heat Build-Up of Materials), which consists of these four different test methods:

2.1 Test method A uses an OSRAM Ultra Vitalux radiation source to simulate solar radiation. The surface temperature is measured contactless.

2.2 Test method B uses a defined infrared radiation source to heat up the specimens. The radiation is controlled by a black standard thermometer to 80°C. The surface temperature is made with a non-contact thermometer.

2.3 Test method C refers to ISO 17502 (Leather – Determination of Surface Reflectance). ISO 17502:2013 specifies a method for determining the reflectance properties of leather surface for visible and near infrared radiation.

2.4 Test method D, in general, is identical to EN 16795 and applicable in common laboratory weathering instruments.

According to EN 16795, a xenon or metal halide arc lamp, fitted with filters, can be used to simulate the spectral irradiance of global solar radiation. The specimens are exposed to various levels of simulated global solar radiation, heat, and relative humidity and air flow under controlled environmental conditions, including:

- the irradiance level,
- the air flow directed over the test specimen,
- the ambient air temperature during the exposure, and
- the relative humidity in the chamber during the exposure.

The procedure includes measurement of the global irradiance and surface temperature in the plane of the specimens. It is recommended that test specimens be exposed simultaneously with a black standard (BST) and white standard (WST) thermometer as specified in ISO 4892-1 to provide a standard for comparative purposes.

Table 1 specifies the minimum and maximum levels of the relative spectral irradiance in the visible and infrared wavelength range.

Spectral Passband (l = wavelength in nm)	Relative Spectral Portion (%)
290 ≤ l ≤ 800	60 ± 9
800 ≤ l ≤ 3000	40 ± 9

Table 1: Relative spectral irradiance of laboratory radiation sources simulating global solar radiation

The surface temperature on the sample level can be measured with a non-contact thermometer such as Atlas' Specific Specimen Surface Temperature (S^3T) system (see Figure 1). Surface temperature can also be measured with a thermally sensitive element such as a platinum resistance sensor (RTD) or thermocouple mounted in good thermal contact with the center of the specimen on the side opposite the radiation source. The RTD or thermocouple is thermally insulated from the surrounding ambient air, the radiation and forced air flow. The construction principles used are for a BST sensor in accordance to EN ISO 4892-1.

Test conditions are listed in Table 2. An irradiance of 300 nm to 3000 nm is relevant for this test.

Cycle No.	Time of Day	Irradiance (300 nm to 3000 nm) W/m²	Chamber Temperature °C	Wind Speed m/s
1	Morning and afternoon	600	38	0.5 - 2
2	Morning and afternoon	600	Uncontrolled	> 1
3	At noon	1100	38	0.5 - 2
4	At noon	1100	Uncontrolled	> 1

Table 2: Exposure conditions for typical times of day (summer, cloudless, horizontal)

The irradiance between 300 nm and 3000 nm is a function of the lamp wattage for a given radiation source and filter system. If the irradiance is not measured in the indicated passbands, the instrument manufacturer should provide the relationship between irradiance and lamp wattage. Also, air speed information on the sample level is needed from the instrument manufacturer. Exposures can be conducted either with the relative humidity controlled at a specified level, preferably 30 HR (± 10%), or without control. When the thermal equilibrium during the test is achieved, the surface temperature is measured by either the thermally sensitive element or the pyrometer.

The surface temperature measured according to EN 16795 gives a good estimate of the in- service temperature of flat surfaces. ■

SunSpots

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