ATLAS
MATERIAL TESTING SOLUTIONS

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Underwriters Laboratories

Atlas collaborates with Underwriters Laboratories to advance testing for solar industry.
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In This Issue

Innovation in the Analysis of Weathering-Induced Color Changes in Plastics

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Abstract

Developing formulations for colored plastic products often requires color stability tests involving lengthy outdoor weathering. Currently, the only method for reducing this outdoor weathering time is accelerated artificial weathering. With the goal of saving even more time, a new color measurement system (Catscope, ERT-Optik GmbH) was investigated in this research project.

The Catscope was developed for investigating weathering-induced color changes in paint systems. With paint samples, color changes can be accurately measured after a short exposure time and then extrapolated for longer weathering times. The purpose of this study was to investigate the suitability of Catscope for the measurement of weathering-induced color changes in plastics. After verifying the reproducibility of Catscope measurements for plastics, the results were correlated with a conventional spectrophotometer measurement. In addition, some new extrapolation functions were tested in order to adjust the prediction for plastic parts.

Experimental

Sample Preparation

To investigate weathering-induced color changes in colored plastics, test plates were produced by injection molding using a Battenfeld TM 1300/525+130 machine with a two-cavity mold for test plates with different surface structures (polished, brushed finish and two different spark erosion structures). The test plates have dimensions of 100 x 60 x 4 mm and two different surface structures on each. The different plastic/colorant combinations used for the test samples are shown in Table 1.

Continued on page 4

ATLAS • SHOWS

2010

Photovoltaic Technology Show 2010 Europe
Stuttgart, Germany
April 27–29

Control 2010
Stuttgart, Germany
May 4–7

PV Expo 2010
Shanghai, China
May 5–7

Hightex 2010
Istanbul, Turkey
May 15–18

ITMA ASIA 2010
Shanghai, China
June 22–26

Asia Pacific Coatings Show
Jakarta, Indonesia
June 23–24

25th EU PVSEC
Valencia, Spain
September 6–9

Indiapack 2010
Mumbai, India
September 30–October 3

Solar Power International Show
Los Angeles, California, USA
October 12–14

K-Show 2010
Düsseldorf, Germany
October 27–November 3

Vietnam Hanoi Textile & Garment Industry Expo
Hanoi, Vietnam
November 10–12

Eurocoat
Genoa, Italy
November 9–11

Learn about the latest weathering developments and how Atlas® can help advance your testing program. Visit our booth at these shows, and one of our representatives will be happy to talk with you about your testing goals and needs.

For the latest on Atlas shows and presentations, visit www.atlas-mts.com.

IN MEMORIAM

Industry Loses Two Leaders

Patrick J. Brennan, Vice President of Q-Lab Corporation, Westlake, Ohio, died September 20, 2009, at age 60. During his 30-year Q-Lab career, he became established as a true expert in the field of accelerated weathering and lightfastness. He was an active member of ASTM, ISO, and AATCC standards organizations.

An ASTM member since 1986, Brennan participated in numerous committees and more than 50 subcommittees. He served as the D20.50 (Durability of Plastics) Subcommittee chairman from 1991–2006, and was honored with the D20 Award of Appreciation in 2000 and the G03 (Weathering and Durability) Committee Chairman of the Year Award in 2001. He was an active member of AATCC for 23 years, participating in several research committees. Former chair of the Weather Resistance Test Methods and the Colorfastness to Light Test Methods committees, he also served as the U.S. expert for the ISO light stability and weathering committee. He served on ISO TC38 for textiles and ISO TC61 for plastics from 1992–2005.

Brennan published numerous technical papers on weathering and lightfastness and taught audiences around the world. His contributions to the science of weathering and light stability have been immeasurable.

Warren D. Ketola, a longtime member and driving force within ASTM International, died on December 3, 2009, at age 61. Known as the pre-eminent North American "standards guy," Ketola was active in ISO, AATCC, and especially ASTM, where he had been a significant influence since 1982. In a measure of his dedication to the standards process, Ketola was writing an ASTM ballot negative only a few days before he died.

Ketola brought years of expertise in weathering plus a healthy dash of humor to every committee and meeting in which he participated. In ASTM alone, he served in Committees C24, D01, D04, D08, D20, D35, E06 as well as G03, where he presided for many terms as chairman. His many ASTM awards and honors included the D 20 Committee on Plastics Award of Appreciation; the Award of Merit for work on the G3, D1, and D20 Committees; the D20 Committee on Plastics Recognition Award; and the G 3 Committee on Weathering and Durability Task Group Chairman of the Year Award.

Ketola retired from 3M Company in 2008 as a division scientist and co-founder of the 3M Weathering Resource Center. He was instrumental in the development of the basic technology for the 3M Post-It™ Note.

Ketola was a dedicated and internationally known expert whose technical contributions significantly advanced the science of weathering. He worked closely with many at Atlas who valued and respected his contributions. He will be missed.

CLIENT EDUCATION • ATLAS

2010

Atlas Client Education helps clients learn to design durability test programs to understand how weathering affects materials. Our education and training solutions will help you and your staff effectively master the skills and knowledge needed to develop long-lived products in shortened development cycles. Our programs are designed for all levels to ensure that everyone develops the skills required to understand the fundamentals of weathering and how to operate our instruments. For the latest schedules and locations, check the Atlas website, www.atlas-mts.com, or e-mail info@atlas-mts.com.

Fundamentals of Weathering I	April 7, June 23, September 29 • Chicago, Illinois, USA *Presented in English*	April 13 • Kolding, Denmark *Presented in English*	May 4 • Vienna, Austria *Presented in German*	May 19 • Paris, France *Presented in French*	June 8 • Frankfurt, Germany *Presented in German*
Fundamentals of Weathering II	April 8, June 24, September 30 • Chicago, Illinois, USA *Presented in English*	April 14 • Kolding, Denmark *Presented in English*	May 5 • Vienna, Austria *Presented in German*	May 20 • Paris, France *Presented in French*	June 9 • Frankfurt, Germany *Presented in German*
Xenotest® Workshop	March 17–18 • Linsengericht, Germany • *Presented in German*				
SUNTEST® Workshop	May 11 • Linsengericht, Germany • *Presented in German*				
Weather-Ometer® Workshops	March 30–31 • Linsengericht, Germany *Presented in English*		April 6, June 22, September 28 • Chicago, Illinois, USA *Presented in English*		

Case Studies Now Available on Atlas Website

Light- and weatherfastness testing of materials, components, and finished products is essential for fulfilling product warranty claims, meeting rigorous industry standards, and staying one step ahead of the competition.

To understand the full picture and ensure quality throughout their entire process, companies rely on Atlas' Network of Weathering® beginning with proper design of experiment and incorporating material screening, accelerated laboratory testing, outdoor weathering testing, and independent laboratory validation.

Even though your product or material formulation may be unique, the methodology behind the proper testing may not. That's why Atlas offers case studies on a range of topics:

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- Window and seal profiles
- PET bottles
- Car tires
- Artificial grass yarn
- Agricultural films
- Styrenic thermoplastic elastomers
- Realistic Food & Drink Testing Study

These case studies can easily be downloaded at **www.atlas-mts.com.** Visit our weathering library in the Client Education section to begin your download.

Looking for case studies on other products? Or would your company be interested in cooperating on a future case study for one of your products? We want to hear from you! Please contact us at info@atlas-mts.com.

ATLAS • SPEAKS

Printed Electronics and Photovoltaics Europe 2010

April 13–14
Dresden, Germany

"How Long Does Your Module Live? Methods to Simulate Environmental Ageing of PV Modules in an Accelerated Way"

Speaker: Andreas Riedl

6th World Flexible Intermediate Bulk Container (FIBC) 2010 Congress

April 20–21
Amsterdam, The Netherlands

"Chances to Improve Accelerated Weathering"

Speaker: Cees van Teylingen

Cleveland Coatings Society 53rd Annual Technical Symposium Sink or Swim 2010

May 18–19
Akron, Ohio, USA

"Advancements in Verifying Conformance to Weathering Test Methods for Coatings"

Speaker: Matthew McGreer

Color Changes in Plastics, from page 1

Table 1: Overview of Samples Composition

Polymer	Producer	Type	Colorant	Variations
ABS	Dow	Magnum 3504	Without colorant	
PMMA	Evonik Röhm	Plexiglas 7M	Colored green with 4% masterbatch formulation: phthalocyanine green, PG 7 + bismuthvanadate yellow, PY 184; concentration: 0.52 %	
PE-HD	LyondellBasell	Hostalen GC 7260	Pre-compounded with diketopyrrolopyrrole red (PR 254)	In concentrations 0.1 %, 0.2 % and 0.4 %
PA66	BASF	Ultramid A3W	Colored blue with 4% masterbatch formulation: titanium dioxide, PW 6 + cobalt blue, PB 28 + PB 36 + carbon black, PBl 7; concentration: 0.84 %	Variation of surfaces structures: polished, with a brushed finish and 2 different spark erosion structures

Weathering of Samples

In one case, outdoor weathering was performed in Würzburg with some of the samples at the weathering station of the SKZ according to DIN EN ISO 877. The samples were angled at 49° and oriented facing south.

The solar radiation data were received from DWD (Deutscher Wetterdienst). The exposure lasted from February 2008 to March 2009. This duration is equivalent to a radiation dose of about 2800 MJ/m² in the wavelength range from 300 to 800 nm.

In the other case, samples were exposed to an artificial climate in an artificial weathering device (Xenotest® BETA LM, *Atlas*) with following the parameters according to DIN EN 513:

Table 2: Parameters for the Artificial Weathering

Parameter	Value
Spray cycle (dry/spraying)	102 min/18 min
Irradiance	60 ± 2 W/m² (at 300–400 nm)
Black-standard temperature	60 ± 3 °C
Relative humidity	65 ± 5 %

As the most critical factor of an outdoor exposure, the irradiation dose of the wavelength range from 300 to 800 nm was selected to compare the effects of these different weathering methods.

Color Measurements

Catscope

The Catscope does not measure color quantitatively, but determines color variation comparatively to a reference sample. It was developed by ERT-Optik Dr. Thiel GmbH. The Catscope works with a conventional flatbed scanner. But the core of this innovative color measurement system is its software. It is based on the so-called TTFTR (Ten Times Faster to Result) method, a patented solution for detecting color changes by pattern recognition [1]. With this software, even very small color changes can be detected with high precision.

Spectrophotometer

Reference measurements were performed with a standard spectrophotometer (ColorEye 7000A, *GretagMacBeth*) to check the results obtained with Catscope. It works with an integrating sphere (d/8°), in contrast to Catscope which measures color with a directed configuration. For comparison with the Catscope, measurements were taken in SCE (specular component excluded) mode with opened light trap, with illuminant D50 and 2° observer.

Results and Discussion

ABS:

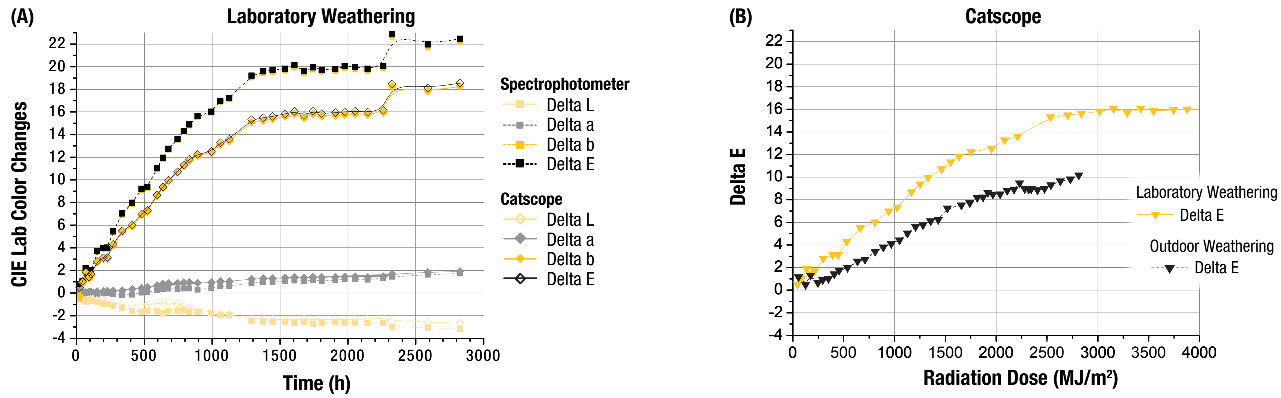

Figure 1: *a) Color fading depending on weathering time in laboratory*
b) Color fading depending on radiation dose in laboratory and outdoor weathering

A visual color matching shows that upon weathering the color changes from white to yellow. This change can be detected by both of the color measurement methods. The variation of parameters *L* and *a* are nearly identical for the spectrophotometer and the Catscope. But parameter *b* varies between the measurement systems and therefore the total color change ΔE (arithmetic mean of ΔL, Δa, and Δb) does too. ΔE measured with the spectrophotometer is slightly higher than the one measured with Catscope (see Figure 1a).

Weathering in laboratory and outdoor weathering can be compared according to the radiation doses in the wavelength range from 300 to 800 nm. Laboratory weathering causes a stronger color change than outdoor weathering. This may be due to the fact that the constant surface temperature in laboratory weathering is higher than the average surface temperature in outdoor weathering. This can increase the aging rate (see Figure 1b).

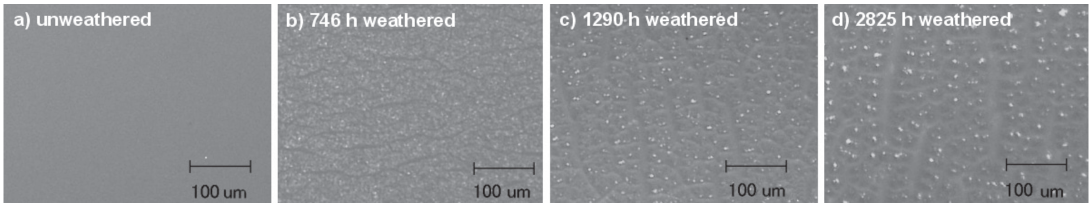

Figure 2: *Light microscope pictures of artificial weathered surfaces at different weathering stages*

Figure 2 shows the sample surfaces at different stages of artificial weathering. As the weathering time increases, the quantity of cracks on the surface also increase. At 746 h the first cracks can be already detected. This can be attributed to the sensitivity of ABS (without stabilizer) to weathering [2].

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Color Changes in Plastics, from previous page

Green-Colored PMMA:

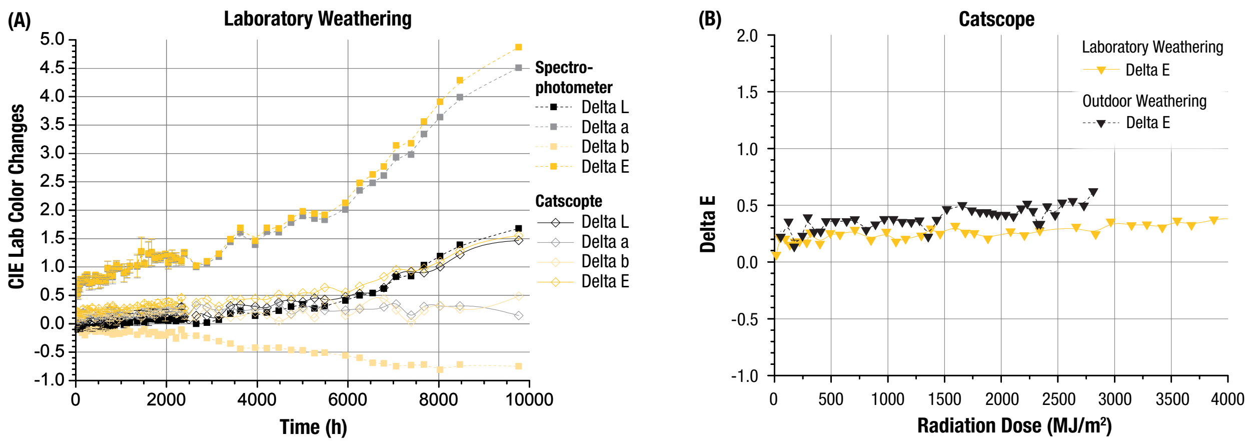

Figure 3: *a) Color fading depending on weathering time in laboratory*
b) Color fading depending on radiation dose in laboratory and outdoor weathering

Even after nearly 10000 h of artificial weathering, the green PMMA shows only a slight brightening compared to the reference sample in visual color matching. The spectrophotometer and Catscope partially confirm this observation, since the variation of the lightness *L* over time is nearly identical for both measurement systems and remains small (see Figure 3a). Likewise, Catscope shows almost no change for color values *a* and *b,* which matches the visual observation. However, the values of *a* and *b* measured with the spectrophotometer differ significantly. This may be due to the measurement settings, which had to be applied for comparison reasons. Other analytical methods, like light microscopy or IR-spectroscopy, showed no detectable ageing.

Furthermore, the comparison between outdoor and laboratory weathering shows a good correlation (see Figure 3b).

Red-Colored HDPE:

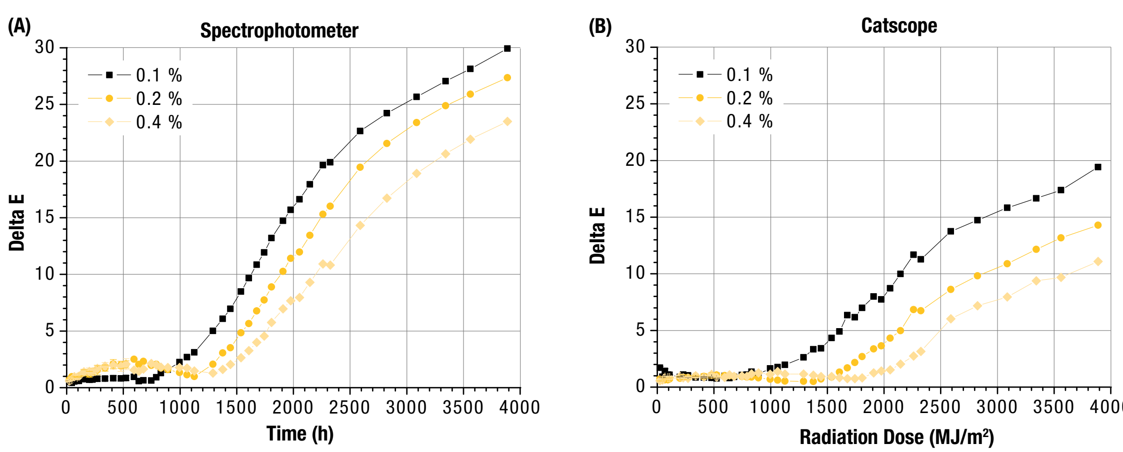

Figure 4: *Color fading depending on weathering time in laboratory, measured with spectrophotometer (a) and Catscope (b) for different colorant concentrations*

Artificial weathering induced a significant color change for all PE samples, regardless of the colorant concentration. They became less colorful and bleached. However, as shown in Figure 4, the variation of the total color change ΔE over time depends clearly on the colorant concentration, for both the spectrophotometer and the Catscope: a lower colorant concentration leads to a stronger weather-induced color change. Moreover, an induction time can be noticed before a significant color change occurs. This induction time also increases with the colorant concentration. The two color measurement systems differ only in the absolute values of the color changes, which are higher overall with the spectrophotometer than with the Catscope. Therefore, the detected induction times of the Catscope are longer than those of the spectrophotometer.

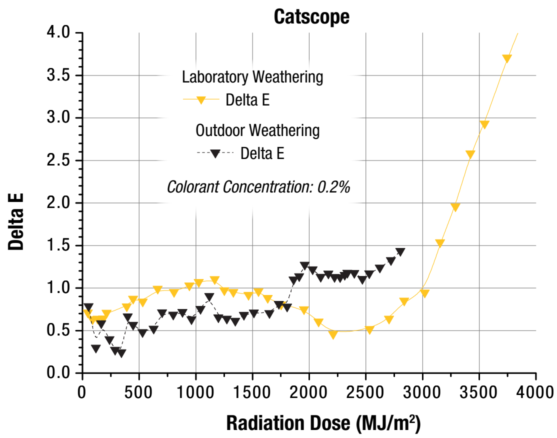

Figure 5:
Color fading depending on radiation dose in laboratory and outdoor weathering

Figure 5 shows a comparison of the color change measured with the Catscope after laboratory and outdoor weathering. At least for the induction period, there is a good correlation between the measurements for both weathering methods. Longer outdoor weathering would be necessary to compare the color fading after induction.

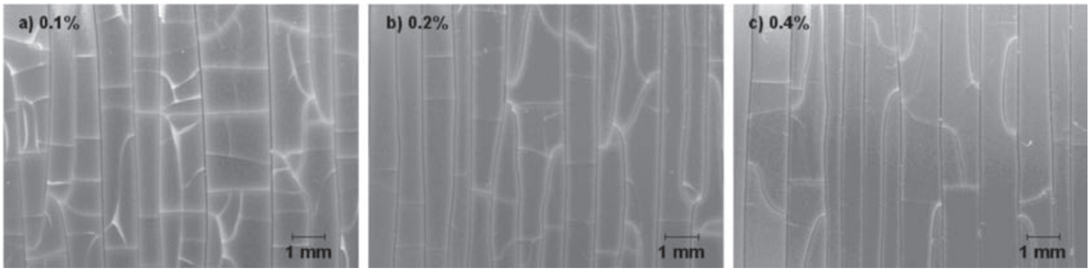

Figure 6:
Light microscope pictures of the sample surfaces with different colorant concentration—0.1% (a), 0.2% (b), and 0.4% (c)—after 3889 h artificial weathering

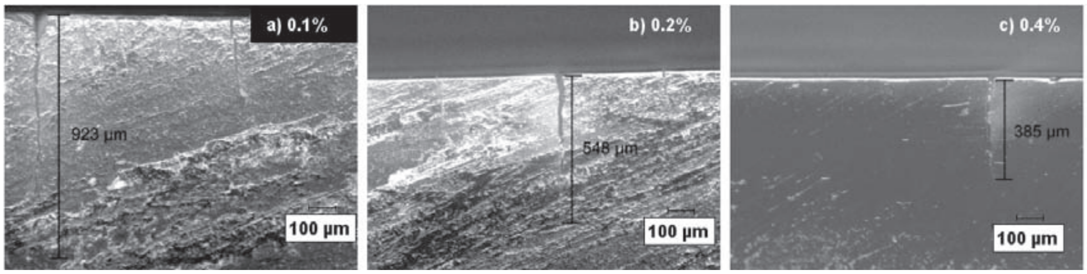

Figure 7:
Cracks resulting from surface embrittlement after 3889 h artificial weathering for PE samples with different colorant concentration: 0.1% (a), 0.2% (b), and 0.4% (c)

Light microscopy shows that the colorant concentration not only affects the color fading but also the embrittlement of the surface. The behavior of the PE samples after nearly 4000 h of artificial weathering can be seen in Figures 6 and 7. All samples show cracks on the surface. Yet the frequency and the depth of these cracks increases with decreasing colorant concentration.

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Color Changes in Plastics, from previous page

Blue-Colored PA66:

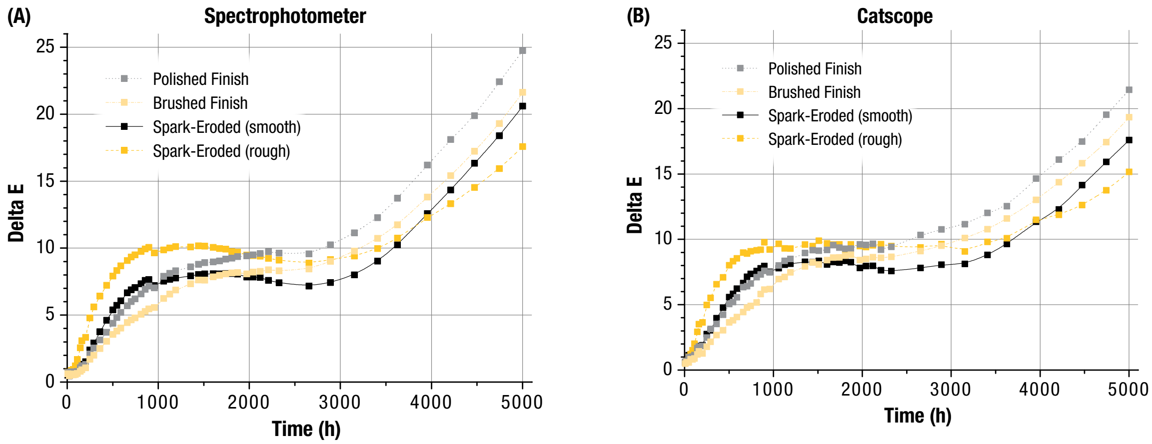

Figure 8: *Color fading depending on weathering time in artificial weathering and surface structure of the samples measured with spectrophotometer (a) and Catscope (b)*

Figure 8 shows the color changes of the PA66 samples with different surface structures after artificial weathering. The variation of color fading over time is similar for both measurement systems. However, the total color change ΔE measured at the end of weathering time with the spectrophotometer is higher than the one measured with the Catscope.

The progression in color change can be divided into three phases. In the first 1000 h of weathering, the color is changing continuously. From 1000 h to approximately 3000 h, the color values remain at an almost constant level. After that, the total color change ΔE increases again. In the first phase, the following relationship can be observed: the intensity of the color change increases with surface roughness, since a rough surface has a bigger contact surface for weathering than a smooth surface. This relationship inverts during phase two, so that in the third phase the strongest change is observed for the smoothest surface. This can be attributed to the cracks which have formed on the surface. They are interfering with the light, leading to a brighter and a less colored impression. This effect is much stronger for initially smooth surfaces.

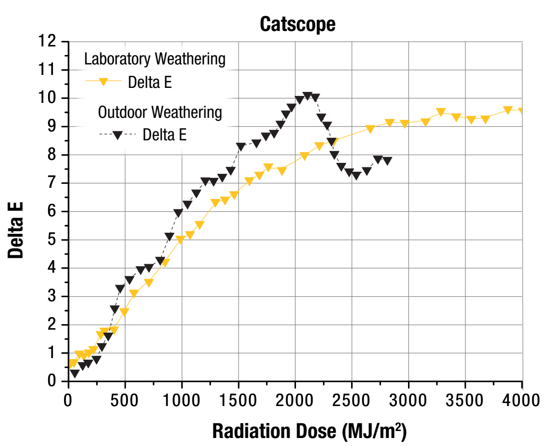

Figure 9:
Fade of color depending on radiation dose in laboratory compared to outdoor weathering for PA66 with polished surface

Laboratory and outdoor weathering of the PA sample with polished surface are compared in Figure 9. For a radiation dose smaller than 2000 MJ/m², outdoor weathering leads to slightly stronger color changes than artificial weathering. From 2000 MJ/m² to 2500 MJ/m², the value ΔE of outdoor weathering surprisingly decreases before it increases again, with a rate similar to the one before this decreasing period. This phenomenon can be attributed to the outdoor conditions, since this period corresponds to winter 2008–2009. It means that both the surrounding temperature and the radiation intensity were much lower than in artificial weathering, affecting the aging process. Moreover, the winter outdoor conditions also lead to a variation in the water absorption of PA66, which may underlie the change in brightness and thus the decrease of *ΔE*.

Extrapolation of Weathering Results

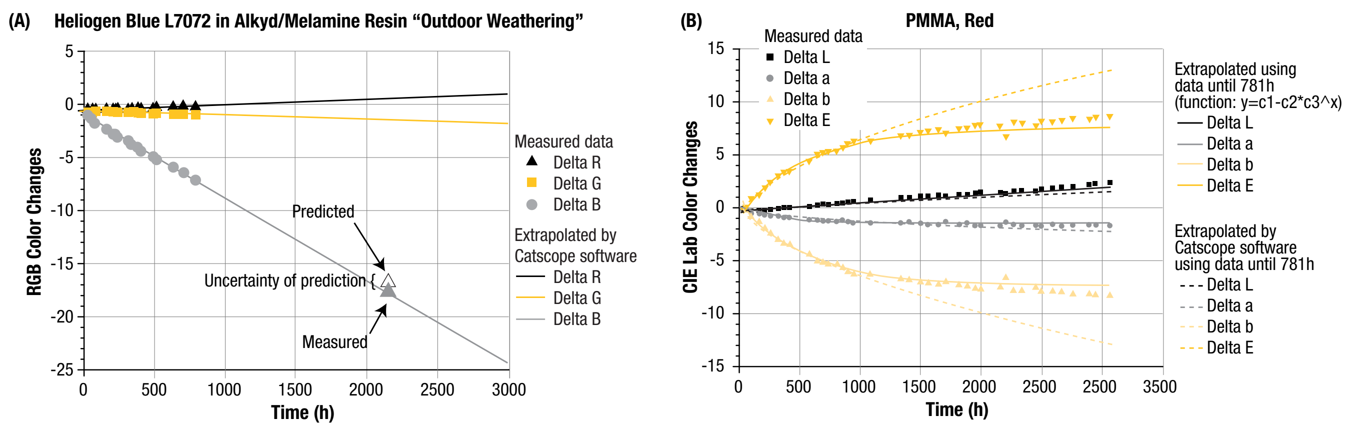

Figure 10: *a) RGB-color changing of a paint-sample with measured and predicted data [3] b) CIE Lab color changes of a red-colored PMMA sample with measured data and extrapolated curve progression*

The Catscope and its algorithm for extrapolation were specifically developed to examine paints. Figure 10a shows the change of reflectivity of a paint sample in the values RGB (red, green, blue). The measured data were extrapolated with the Catscope software from 800 h to approximately 2000 h. For control, the sample was allowed to continue weathering and was measured again after 2000 h. The extrapolated value shows good consistency with the real color change.

In preliminary investigation, attempts were made to apply the extrapolation to weathering-induced color changes of plastics for a red-colored PMMA sample. The results are displayed in Figure 10b. Using the algorithm implemented in the Catscope with data up to 781 h doesn't produce a satisfying extrapolation to weathering longer than 1000 h. The Catscope uses a polynomial function for extrapolation. Other mathematical functions were developed and tested in this study. The exponential function $y=c_1 - c_2 \cdot c_3^{\,x}$ was the most suitable to extrapolate the three color values *ΔL, Δa,* and *Δb,* and therefore ΔE, with good accuracy.

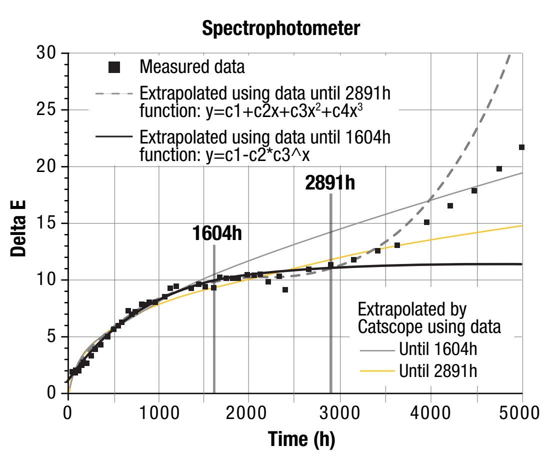

Figure 11: *Color fading of the PA66 sample with polished surface: measured data and different extrapolations*

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Color Changes in Plastics, from previous page

Using color measurements after artificial weathering of the PA66 sample with polished surface, such extrapolations were also performed, without satisfying results (see Figure 11). This example shows that a general extrapolation function for weathering-induced color changes is difficult to find in case of plastic/colorant combinations.

The extrapolation works much better for paint systems. One reason could be that such systems contain up to 50% colorant and that, in most cases, the pure matrix polymer is very weathering-resistant [4]. Thus, a weathering-induced color fading of the so-called clear coat is normally moderate. That's why the whole paint/colorant system behaves in general like the colorant itself. Therefore, the variation of color fading over time can be described much more easily. On the contrary, colored plastics contain maximum 4% colorant [4]. The behavior of color fading is still influenced by the colorant but also depends on the behavior of the polymer and its stabilization package. That's why the variation of color fading over time differs significantly from system to system.

Conclusion

For nearly all plastic/colorant systems investigated, the Catscope yielded values for color fading, which were qualitatively consistent with the spectrophotometer results. Differences between the two measurement systems can be explained by the different measurement geometries used: the integrating sphere (spectrophotometer) in contrast to the directed geometry of a flatbed scanner (Catscope). Weathering investigations with a spectrophotometer usually employ the SCI-mode (specular component included) to remove effects of the surface quality on the results of color measurement. However, the SCE-mode (specular component excluded) was used in this study in order to enable the comparison with the Catscope. The Catscope shows a reproducibility similar to the one of the spectrophotometers.

A clear advantage of Catscope is its price. Using a conventional flatbed scanner, Catscope is much cheaper than the complex technical setup of spectrophotometers. The core of a Catscope system is its software. It employs a patented pattern recognition to detect color changes with high precision.

The variation of weathering-induced color changes over time could be extrapolated for individual plastic/colorant systems. But no general function for all plastic/colorant combinations could be found. Every combination has to be investigated separately.

In most cases, outdoor weathering and artificial laboratory weathering showed a very good consistency. Artificial weathering leads to slightly stronger color changes than outdoor weathering.

Upon weathering, the stability of the HDPE sample increased, with colorant concentration up to 0.4%. This trend is specific to the colorant used (diketopyrrolopyrrole).

Finally, both the initial surface roughness and the changes in the surface topography upon weathering (like aging-induced cracks) had also a significant effect on color fading. A rougher surface leads to a faster color change.

Acknowledgments

The authors gratefully acknowledge the financial support for this research project (project code 15255 N) from the German Federal Ministry of Economics and Technology, supported by the German Bundestag through AiF in the program IGF.

The authors would also like to thank the companies involved in this study as well as the people at SKZ.

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SEPAP More Effective than Ever

SEPAP 12/24 is an affordable accelerated photoaging unit specially adapted to examine photodegradation mechanisms of polymeric formulations in laboratory conditions. It was designed in the 1970s by photochemists from the University of Clermont-Ferrand (France) as an analytical tool to understand the degradation mechanisms of naturally aging polymers at the molecular level. The SEPAP unit replicates the chemical changes in accelerated, controlled lab conditions that are achieved through long-term, natural weathering conditions, from which similar changes in macroscopic properties (mechanical, aesthetical, etc.) can be expected. Assessing the photodegradation mechanisms of polymers, also known as mechanistic approach* has been approved by ISO Committee TC61-SC6N to become a standard.**

SEPAP 12/24's design relies on fundamental concepts of macromolecular photochemistry. The units are built as parallelepiped chambers with four medium pressure mercury arc lamps in borosilicate envelops that emit discrete radiation at 290, 313, 365, 405, 436, 547, and 579 nm. The light source is not used to simulate daylight but to induce the same photochemical processes as daylight. Samples are homogeneously exposed on a rotating support in the center of the chamber. The surface temperature of the samples is accurately controlled and maintained between 50 and 80°C ±1°C through a thermocouple placed behind a reference film with same color and chemical composition as the exposed samples.

The SEPAP unit has been accepted by European industries and standards organizations. Among others, it serves the following industries:

- Producers of greenhouse and silage films
- Cabling industry
- Automotive OEMs
- Polymer and additive producers

For more information on the SEPAP 12/24, please contact your local Atlas sales representative. ■

* *For more information on the mechanistic approach, please see Dr. Olivier Haillant's article, "Polymer Weathering: A Mix of Empiricism and Science" in SunSpots Issue 76.*

** *Draft International Standard ISO/DIS 10640 Plastics – Method of assessing accelerated photoageing by FTIR and UV/visible spectrometry*

Xenotest® 220/220+
Lightfastness Testing Continues to Improve After 55+ Years

Atlas® has debuted the latest generation of xenon test instruments for lightfastness testing of textiles. The Xenotest 220/220+ was unveiled at the AATCC Global Conference and Exhibition in January in Mumbai and hit the commercial market in March.

Designed to fit seamlessly into the Xenotest series, the Xenotest 220/220+ is ideal for lightfastness testing to common standards such as ISO 105-B02 and AATCC TM16. This modern, cost-effective and reliable xenon test instrument has a testing capacity of 38 samples and works well for both small and large companies. New sample holders were designed with a quick-insertion feature to save time. The Xenotest 220/220+ also has a user-friendly touch screen control to make programming easy and safe. The touch screen comes standard with both Asian and European language capability.

Larger labs with multiple Xenotest instruments or more than one laboratory will also appreciate the newly available XenoTouch Add-ons, which allow the Xenotest 220+ to be monitored and programmed online remotely.

For more information, please visit the Atlas website at **www.atlas-mts.com** or contact your local Atlas sales representative.

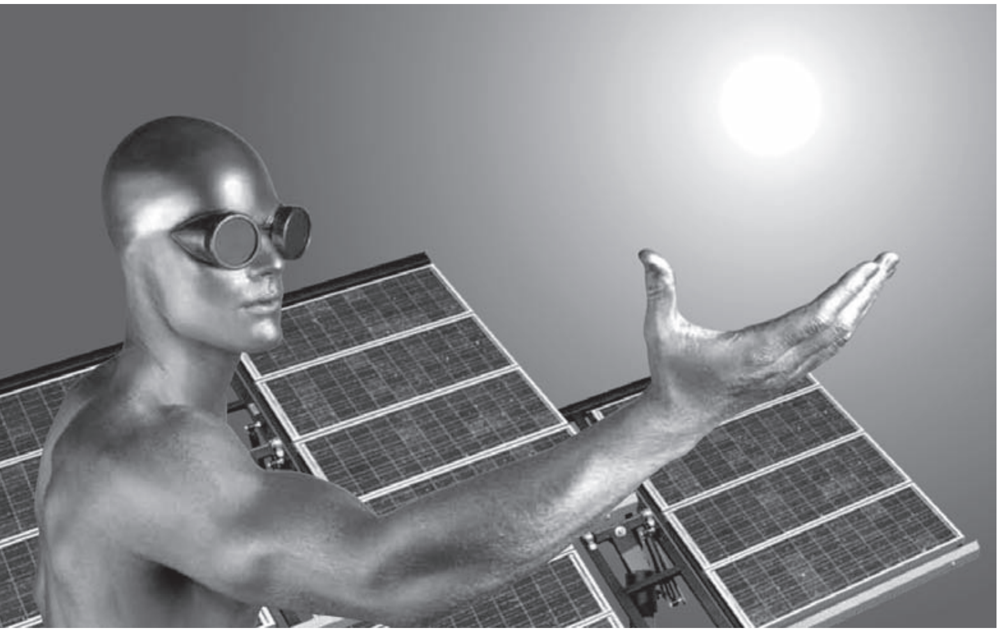
Look for the Xenotest 220 at ITMA ASIA and Hightex 2010!

New Atlas® Program Tests PV Module Durability

Atlas has taken a broad leap forward in the solar energy industry with the Atlas 25PLUS™ test program for determining the durability of photovoltaic (PV) modules.

PV modules are expected to reliably perform for more than 25 years. In addition to hardware warranties for material defects, performance warranties for power generation typically guarantee that output will not fall below 90% in the first 10 years or 80% after 20+ years.

Traditional silicon modules have largely demonstrated good durability. However, today's products, which use more cost-effective materials, packaging, and processing, are less tested and less consistent. For example, thin-film silicon designs and other PV semiconductors, such as CdTe, GaAs, and CIGS, each have very different degradation mechanisms and environmental sensitivities.



The testing of weathering-related failures and the estimation of service life and performance is critical not only for new product development but also to satisfy financial stakeholders at all levels: venture capital, OEM warranty set-asides, bank financing, and system insurers.

Given the size of these modules, most testing to date has been limited to extending the basic IEC qualification of thermal cycling and damp heat tests, but the modules' complex structure requires more comprehensive weathering testing.

The Atlas 25PLUS program improves upon basic accelerated weathering tests by combining wider climate-based parameter ranges and sequencing between short-term diurnal and longer-term seasonal cycles. Utilizing the large-scale accelerated weathering capabilities at Atlas' Solar Test Center, this one-year testing program is designed to provide natural and laboratory accelerated weathering stresses equivalent to 10–30+ years of service, providing data to support warranty and performance claims.

The program is based on a combination of accelerated outdoor and laboratory exposures:

- UV, salt fog corrosion, and condensing humidity tests
- Solar tracking in Arizona, including peak summer
- Chamber exposure cycles combining full-spectrum solar, temperature, humidity, and freezing in both climate-based short-term and long-term patterns to replicate natural delivery
- Modules powered under resistive load during solar exposures
- Periodic measurements of I-V performance factors, visual inspections, digital photographs, and IR thermal imaging. Additional services, such as wet leakage current testing, are also available

The program provides otherwise unattainable data that is useful for identifying module failure modes or performance loss as well as supporting, validating, or improving product design (e.g., packaging, cables, connectors, junction boxes, and micro-inverters). For more information, contact Stefani Levine, Marketing Manager, at **slevine@atlas-mts.com.**

Atlas Announces Strategic Alliance with Underwriters Laboratories

Two Global Players Come Together to Meet Testing Capacity and Durability Needs of Solar Industry

Underwriters Laboratories (UL), a world-leading independent third-party safety testing and certification provider, has entered into a strategic alliance with Atlas Material Testing Technology, a global leader in accelerated weathering instruments and weathering testing services. This alliance benefits both companies with increased global testing capacity and expertise in accelerated aging performance and enables them to provide faster testing and certification turnaround-time for manufacturers specializing in solar energy products.

Collaboration between the two companies has already led to shorter cycle times for some of the customers seeking the UL listing for solar modules and power systems accessory equipment. Not only are outdoor and aging tests for long-term durability a critical component for meeting safety and performance standards, but they also provide manufacturers with the data they need to demonstrate long-term durability to support warranty and performance claims. These tests reduce the costs associated with aftermarket product failures.

"Atlas is highly regarded within the industry for accelerated aging test instruments and associated outdoor and laboratory testing services and we are happy to collaborate with them," said Jeff Smidt, Vice President and General Manager of UL's Global Energy Business. "One of the great benefits that are available through this alliance is the geographical diversity of existing and new testing sites that allows us to minimize project delays that otherwise might occur due to natural weather conditions," Smidt added. Atlas has 21 outdoor weathering sites globally including the Atlas Solar Test Center and exposure facility in Arizona, a benchmark for outdoor exposure testing possessing high levels of solar radiation and elevated temperatures.

For manufacturers around the world, global market access is a vital success factor; and it is an invaluable service offering that is available through this collaboration. For example, for manufacturers of photovoltaic modules in Asia, both North American and international standards must be met (UL 1703 and IEC 61730 respectively), in order to support solar equipment installations in the US and European markets. This alliance allows both companies to significantly increase their global footprint required to support customers globally through localized test sites and highly skilled engineering talent that speaks local languages. This translates into increasing efficiencies and accelerating turnaround-time for existing and future projects.

Rick Weiler, CEO of Atlas Material Testing Technology stated, "We are excited to partner with a well-respected worldwide standards organization and together we will help to meet the global needs of the solar industry. Our combined resources generate the synergies to provide much needed laboratory and outdoor testing capacity for solar panels and equipment."

UL is committed to serving its customers in the photovoltaic industry. Recently, the company has invested heavily in additional capacity for the testing and certification of solar energy equipment through the expansion of its existing and new facilities and partnerships. UL currently operates Photovoltaic Centers of Excellence in San Jose, Calif. and Suzhou, China and will open two new state-of-the-art testing facilities this year: one in Germany and one in Japan. The alliance with Atlas is one more step in the process of serving the global photovoltaic industry as efficiently as possible.

Atlas Certified for Solar Thermal Testing

Development to Help Clients' Time to Market

Atlas has successfully completed an onsite assessment conducted by Solar Rating and Certification Corporation (SRCC) to perform solar thermal testing in accordance with SRCC Standard 100 – Test Methods and Minimum Standards for Certifying Solar Collectors. Upon receiving final SRCC certification, Atlas will be one of only a few U.S. labs that provides this testing, helping to eliminate a certification backlog that has stretched from months to over a year. Flat-plate collectors, both glazed and unglazed, and evacuated tube collectors can also be tested to the requirements of ISO 9806.

To learn more about Atlas' Solar Test Center and PV testing services, please contact a client services representative at 1-800-255-3738 or visit us online at **www.solardurability.com.**

WEATHER EXPERIMENTER'S TOOLBOX

Single Variable: Ramp

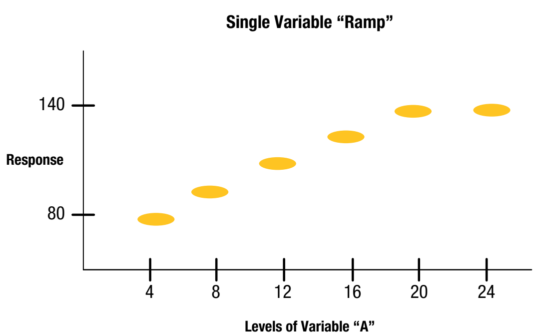
By Henry K. Hardcastle, Atlas® R & D

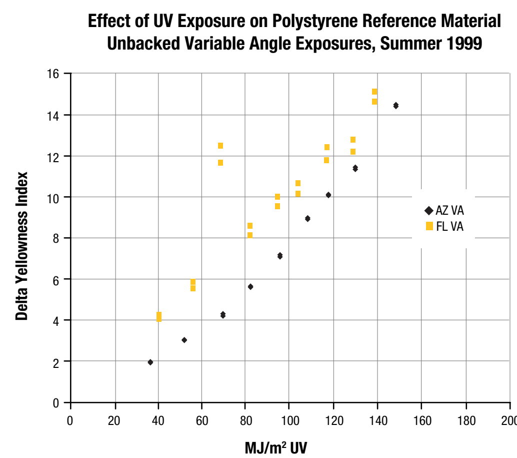
The approaches outlined in the last two issues of *SunSpots®* were interested in "does it?" or "does it not?"—the presence or absence of a characteristic. The next level of sophistication involves a different research question.

Process engineers often use a "ramp" experimental design to determine how much of an input variable effects performance. This design involves amounts of an input variable and represents a higher level of context than simple presence or absence. This design is the most widely used tool for optimizing formulation component levels today.

The following graphic shows a representation of a single variable design with multiple levels of the variable.

Most weathering research utilizes this type of approach for dosage studies. The following experiment changes the dosage of UV and measures the materials' response to the increasing levels.





Atlas® Wins Prestigious R&D Award

Atlas, in partnership with the National Renewable Energy Laboratory (NREL) and the Institute of Laser Technology (ILOT), received the R&D 100 Award for its work in developing the Ultra-Accelerated Weathering System (UAWS).

Advancing beyond Atlas' moderately accelerated EMMA® technology, the UAWS tracks the sun while concentrating reflected sunlight on test specimens mounted in a target area. The new patented mirror system has extremely high reflectance in the UV and near-visible wavelength ranges, while attenuating reflectance in the longer wavelength-visible and IR portions of the solar spectrum.

This technology allows for high concentrations of UV energy without excessive heating of test samples. Used in various applications such as building, solar, and automotive materials, the UAWS achieves results in a fraction of the time needed by other accelerated devices.

The R&D 100 Awards showcase pioneering technology from around the world and have been referred to as the "Oscars of innovation." The UAWS was selected by an independent panel of judges and editors of R & D Magazine.

"Atlas' partnership with NREL and ILOT has allowed us to evolve the science of weathering to new levels, not only with this application, but also a host of related ideas conceived during this project," notes Henry K. Hardcastle, lead Atlas researcher on the project. "These achievements would not have been possible without bringing together the theoretical expertise, manufacturing excellence and application skills represented by the partnership with NREL and ILOT."

R&D 100

TEST INSTRUMENTS GROUP • ATLAS •

PRODUCT UPDATES

XenoTouch Add-ons

New Online Features Make Xenotest® Series and SUNTEST® XXL/XXL+ and XLS+ Easier to Use

Atlas® has introduced new instrument software extensions, or add-ons, for current air-cooled weathering instruments with the latest touch screen control—all aimed at simplifying your daily lab work.

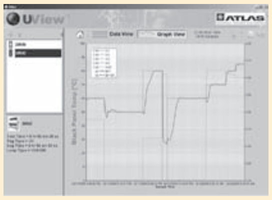
All add-ons require an Internet connection via Ethernet. Access is activated with a code that is provided with the add-on. Atlas will also make the add-ons available on memory cards fitting the instrument interface, offering a simple "plug and play" option.

» **Remote Control** enables instrument programming and operation via remote access. One benefit is the ability to program instruments installed at one or more locations with the guarantee that settings remain as specified; a typical user with limited access level will not be able to make changes.

» **E-Mail Service** enables users to receive copies of the error/warning messages displayed on the instrument touch screen via e-mail—e.g., "The recommended lifetime of lamp is exceeded" or "Parameter monitoring: The irradiance exceeded the given tolerance." A complete list of possible messages is included with the software documentation. The benefit is a closer link to the instrument and the ability to address issues more quickly.

» **Online Monitoring** enables users to watch and print an online instrument status report, including the most important data on running the instrument and test. The benefit is a fast and easy monitoring tool available anywhere you have Internet access.

For more information, please call your local Atlas sales representative.



Remote Monitoring a Snap with Atlas UView

UView, a remote monitoring data acquisition application for the recently launched UVTest fluorescent/UV instrument, is now available.

The application provides an overview of all UVTest instruments running on your network, including instruments' status, the status of any active tests, maintenance/error messages, and sensor readings every 30 seconds. The data is displayed in both tabular and graphical formats to provide a snapshot of recent machine operation. In addition, the data is written to a database, maintained by the application, to allow for simple retrieval in the future.

If the machine is networked, this data will be received, displayed, and logged by UView. Each UVTest can connect to any IP-enabled, Ethernet-based local area network. UView will automatically identify every UVTest on the network and then record any data that it receives while the software is running.

For more information regarding the UView application, please contact your local area sales representative.

Atlas Launches Spray Recirculation System for UVTest™

Atlas is pleased to introduce a new spray recirculation accessory for the newly launched UVTest fluorescent UV test instrument. This feature can dramatically reduce the amount of spray water used for test cycles that require spray.

All common UV/Condensation devices use approximately seven liters of deionized water per minute during a spray cycle. Common test cycles require 15-minute spray phases, usually within a 12-hour test cycle. This results in a total of 210 liters (55.5 gallons) of deionized water used each day. That exceeds the capabilities for some laboratories, and when adding water-purification capacity is cost-prohibitive, the recirculation accessory provides a good solution.

The spray recirculation system utilizes a 53-liter (14-gallon) tank, pump, strainer, and demineralizer filter cartridge. It is designed to be placed in the open storage area below the UVTest exposure cabinet.

Please contact your Atlas sales representative for more information about this new feature.

NOTE: ASTM G154 requires minimum purity levels for spray water. Recirculated water needs to be checked and flushed/refilled by the user based on possible contamination as the water contacts the surface of the exposed specimens.

ATLAS MATERIAL TESTING SOLUTIONS

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SunSpots

Visit the new Atlas website devoted to the solar energy market: **solardurability.com!**

To receive Sun Spots *electronically, please visit www.atlas-mts.com*

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