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How to Meet Increased Quality Performances of Plastic OEM Interior Trims

By Karl Bechtold, Clariant Huningue, France

Abstract

Since plastics were introduced into automobile manufacturing, their use has steadily grown. Exterior as well as interior parts and trims made of plastic are increasingly replacing traditional steel parts, which have been driven by the desire for customized design, production flexibility, weight reduction, and lower material costs. Coatings are applied to improve the appearance of the product and protect the parts from physical and chemical stress. Protection and decorative/aesthetical functions are the main tasks of coatings for exterior parts, whereas special effects such as "soft touch" are often required for interior applications like dashboards, consoles, and air bag covers. The automobile industry is setting higher and higher demands to fulfill the stabilization requirements for vehicle interior coatings. Depending on the target application, heat resistance can be more the focus than light stability alone. The following paper discusses a new stabilization concept that meets both thermal and light stabilization requirements for coatings.

Introduction: Market Penetration and Use of Plastics in Automobiles

Today's cars contain various polymeric materials that are used in exterior, interior, and under-the-hood applications. Cars contain several hundred plastic parts—for example, bumpers, front ends, grills, and mirror housings in exterior applications; instrument panels, trims, consoles, pedals, and sun visors in interior applications; and drive belts, air-intake manifolds, containers for liquids, cable trees, and electric components in under-the-hood applications. See Table 1 (page 3) for others.

In modern automobile manufacturing, plastics are a catalyst for innovation. The motivations are diverse:

- Technical (e.g., bumpers made of polymers meet "impact regulations")

Continued on page 3

Advanced digital control system added to Ci3000+ and Ci4000 Weather-Ometers
Page 14

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AtlasShows

2006

MSV 2006
(48th Intern Engineering)
September 18–22
Brno, Czechia

International Plovdiv
September 25–30
Plovdiv, Bulgaria

Korea Autoparts
Accessory Show
September 26–29
Daegu, Korea

Eurocoat 2006
October 3–5
Barcelona, Spain

Laboratory 2006
October 4–6
Prague, Czechia

Mesurexpo
October 17–19
Paris, France

Fakuma
October 17–21
Hall B 3, Booth 9311
Friedrichshafen, Germany

Test Expo
October 25–27
Booth 16024
Novi, Michigan, USA

HET
October 30–November 3
Utrecht, The Netherlands

IFAI
October 31–November 2
Atlanta, Georgia, USA

ICE
November 1–3
New Orleans, Louisiana, USA

ITCE
November 9–12
Cairo, Egypt

2007

European Coatings
May 8–10
Nürnburg, Germany

ITMA 2007
September 13–20
Munich, Germany

K-2007
October 24–31
Duesseldorf, Germany

AtlasSpeaks

2006

Japanese Weathering Symposium
September 14–15
Tokyo, Japan
Oscar Cordo will present "New Advancements in Weathering Technology."

Coatings for Africa Symposium 2006
October 4–6
KwaZulu-Natal, South Africa
Cees van Teylingen will present "Weathering Resistance: From Material Selection to Final Product Testing."

SLF 18th Conference: "New Spirits for the Development of Future Coatings"
October 8–10
Elsinore, Denmark
Dr. Olivier Haillant will present "The Field of Polymers Weathering: Towards an Improved Reliability of Accelerated Tests."

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

Fakuma
October 17–21
Friedrichshafen, Germany
Andreas Riedl will present "More Than Just Testing—Advantages by Optimizing Weathering Testing Processes."

IFAI Expo
October 31–November 2
Atlanta, Georgia, USA
Kurt Scott will present "Innovations in Laboratory Instruments Revolutionize Automotive Materials Weathering Tests."

ICE 2006
November 1–3
New Orleans, Louisiana, USA
Dr. Olivier Haillant will present "Polymer Weathering: Optimized Test Methods for Improved Service Life Prediction."

4th International Symposium on Service Life Prediction
December 4
Key Largo, Florida, USA
Kurt Scott will present "A New Approach to Characterizing Reciprocity in Xenon Arc."

Quality Performances, from page 1

- Economical (useful for mass production and niche vehicles)
- Aesthetics (more design freedom)
- Environmental (reduction of fuel consumption)

These advantages have led to a dramatic increase in the use of plastics in automobiles over the last 30 years—from an average of about 30 kg per vehicle in the 1970s to more than 125 kg today. This is a more than four-fold increase, and that trend will continue (Table 2, page 4). As a result, overall vehicle weight has decreased considerably, with plastic making up some 8% of a car's total car weight (Table 3, page 4), compared to just 4% in the early 1980s. The biggest growth in the future will be in body application, e.g., front and rear fascias, wheel frames, exterior body panels, or entire roof modules. Substituting conventional materials with plastics leads to a direct primary weight reduction. Assuming an average lifespan of 150,000 kilometers, this weight reduction translates into 750 liters of fuel savings. Table 4 (page 5) summarizes which polymers are used for various automobile parts and the average weight of these parts.

TABLE 1: Plastic Application in Modern Automobiles

Automobile Exterior Applications	Automobile Interior Applications	Under-the-Hood Applications
• Bumpers	• Instruments panels	• Drive belts
• Front ends	• Doors, pillars, and side trims	• Air-intake manifolds
• Grills	• Consoles	• Gaskets and membranes
• Mirrors	• Seats	• Valve covers
• Handles and locks	• Roof liners	• Noise dampening
• Sliding roofs	• Steering wheels	• Fans, fan shrouds, and tension pilleys
• Body components	• Heating/air conditioning	• Fuel-supply components
• Wheel covers	• Cable tree/lighting	• Air-supply components
• Headlamps	• Floor lining	• Oil-supply components
• Tail lights	• Pedals	• Water-supply components
• Windscreen wipers	• Engineering components	• Heating, air conditioning, ventilation
• Glazing		• Cover panels
• Decorative trim		• Electrics
• Shock absorbing components		• Sleeves, dust caps
• Underbody protection		
• Seals		

Coatings for Plastics Substrates

Appearance, quality, and elegance are integral features to the products of today's automobile industry. Therefore, so-called "Class A finishes" are required.

Varnishes and coatings are usually applied to protect the underlying substrate from mechanical and chemical stress and environmental impact. They also give surfaces a finishing touch for a contemporary design. Furthermore, coatings for plastics serve another important function: They hide the differences in gloss and shade that occur due to injection-molding. Coatings help avoid the "plastic look," which often leads to the perception of low quality, and creates the impression of a high-value product. Nowadays, it is not only the design of the auto body that impacts a buying decision, but the design of the interior of the car as well. For these reasons, surface finishing plays an important role.

The Western European market for coatings for plastics was estimated at nearly 112,000 tons in 2003. Automobile component applications represent the largest single sector of the market at roughly 51,000 tons. This results in a market share of 42%. The country distribution is shown in Table 5 (page 5).

To perform their decorative and protective role, varnishes and coatings have to be resistant against the impact of weather. The damaging effect of UV-radiation, oxygen, humidity, and air pollutants on the polymer material can lead to a complete delamination of the layers from the coating below, or the substrate. If this happens, the coating layer can not protect the substrate, and the next stage is the decomposition of the substrate itself. To prevent this, special protective chemicals were developed that are added to varnishes and coatings.

Continued on next page

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TABLE 2: Plastics Usage in Automobiles

North America

Year	kg/Vehicle
1970	31.75
1988	68.04
1999	116.57
2000	115.67
2005	126.55*
2010	139.25*

*Estimate

Source: Automotive Plastics Report – 1999, 2000 Market Search, Inc., Toledo, Ohio

Europe

	1970	1980	1990
France	39	71	98
Germany	56	80	104
Italy	39	79	98
Western Europe	47	77	100

Source: Mavel report

Light Stabilization of Automotive Exterior and Interior Trim

Coatings applied on plastic parts serve both a protective and an aesthetic function. Protective coatings are commonly used to extend the practical outdoor application and lifetime. But when exposed to sunlight for extended periods of time, a coating produced from an organic polymer also is subject to degradation. To enhance the durability, stabilizing additives such as ultraviolet light absorbers (UVAs) and/or hindered amine light stabilizers (HALS) or combinations thereof are added to the coating's formulation. Gloss and color retention and crack and peeling resistance are the main properties such coatings have to fulfill. In this study a 1:1 combination of a UV-absorber of the benzotriazole class together with a HALS were used. In solventbornes, 100% active stabilizers were used; preparations of crystalline products as aqueous dispersions helped to stabilize waterbornes. The stabilizer's concentration was 1% active each, based on total solid resin. Solventborne and waterborne 2-pack polyurethanes consist of OH-functionalized polyacrylates. All applied additives and as well as all coatings raw materials are commercial products.

Sample Preparation

The waterborne silver metallic basecoat was prepared according to a standard procedure and applied onto plaques of PC/PBT-blends. After a pre-drying of over 3 minutes at 80 °C, the clear coats were applied. Curing of solventbornes was 30 minutes at 80 °C. After a flash-off period of 15–30 minutes, the waterbornes were baked over 45 min at 80 °C. The basecoat thickness was in all cases 15±3 µm, and the clear coat thicknesses, 40±5 µm. To ensure that the chemical reaction of the hardener with the resin was finished, the panels were stored for at least 10 days at room temperature prior to testing.

Xenon Weather-Ometer® Conditions

An Atlas Ci4000 Weather-Ometer® was operated at a controlled irradiance level of 0.55 W/m² at 340 nm with quartz 214 inner and Type S borosilicate outer filters. The weathering program is consistent with the standard SAE J1960 August 2003. The cycle is: spray from the front and the back for 60 minutes in the dark at a black panel temperature of 38 °C and 95% relative humidity followed by a second phase of 40 minutes light without spraying at 70 °C black panel temperature and 50% relative humidity and, further, 20 minutes of light with water spray from the front at 50 °C black panel temperature and 95% relative humidity. The fourth phase is 60 minutes of light exposure without spraying at 70 °C black panel temperature and 50% relative humidity.

The change in the degree of gloss was estimated through measurement of the reflectometric value in accordance with DIN 67 530 at a 20° angle using a haze-gloss reflectometer type 4600 (Byk-Gardner). Color change was performed by instrument evaluation with the

TABLE 3: Distribution of Materials of a Typical Car [kg] and [%]

Steel	807.8	60.66%
Iron	156.5	0.75%
Aluminum	116.2	8.73%
Copper and Brass	20.9	1.57%
Zinc	5.0	0.37%
Plastics	114.8	8.62%
Rubber	66.0	4.96%
Glass	44.7	3.35%
Total	1331.8	100.00%

Source: Ward's Motor Vehicle Facts & Figures 2002, Ward's Communications, pp. 60–61

TABLE 4: Types and Quantity of Polymeric Material Used in an Average Car

Part	Main Plastic Type	Weight in Average Car [kg]
Bumpers	PP, ABS, PC	10.0
Seats	PUR, PP, PVC, ABS, PA	13.0
Dashboard	PP, ABS, PA, PC, PE	15.0
Fuel Systems	PE, POM, PA, PP	7.0
Body (including body panels)	PP, PPE, UP	6.0
Under the Hood Components	PA, PP, PBT	9.0
Interior Trim	PP, ABS, PET, POM, PVC	20.0
Electrical Components	PP, PE, PBT, PA, PVC	7.0
Exterior Trim	ABS, PA, PBT, ASA, PP	4.0
Lighting	PP, PC, ABS, PMMA, UP	5.0
Upholstery	PVC, PUR, PP, PE	8.0
Other Reservoirs	PP, PE, PA	1.0
Total		**105.0**

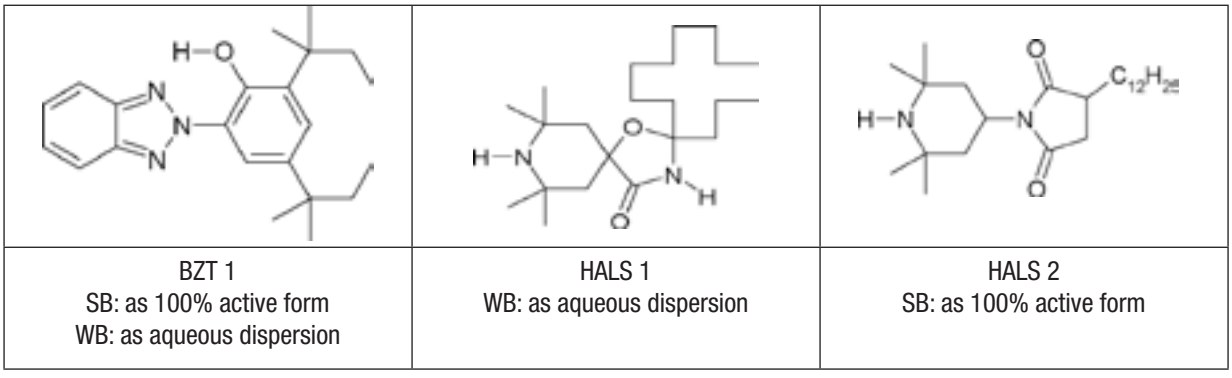
Source: APME 1999

TABLE 5: Western European Market for Coatings for Automobile Plastics in 2003 (Tons)

Country	Volumes (Tons)
Germany	18,260
France	11,880
Spain and Portugal	8,100
UK and Ireland	5,940
Italy	3,780
Benelux	1,440
Sweden	1,080
Switzerland	300
Total	**50 780**

Source: The Western European Market for Coatings for Plastics, IRL, 2004

FIGURE 1: Chemical Structures of Light Stabilizers Used



BZT 1	HALS 1	HALS 2
SB: as 100% active form WB: as aqueous dispersion	WB: as aqueous dispersion	SB: as 100% active form

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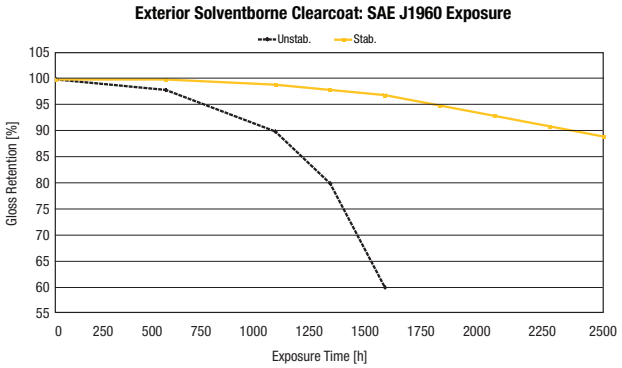
FIGURE 2: Gloss Retention Upon Accelerated Weathering



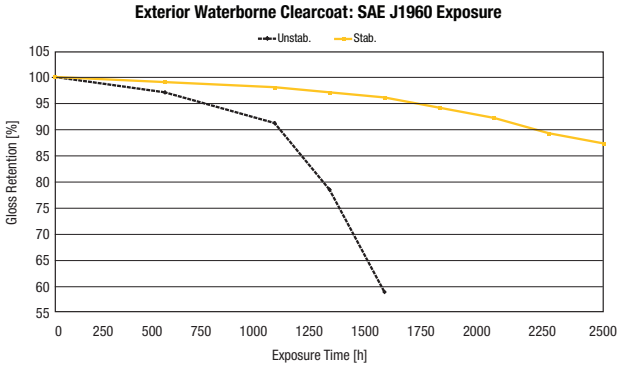
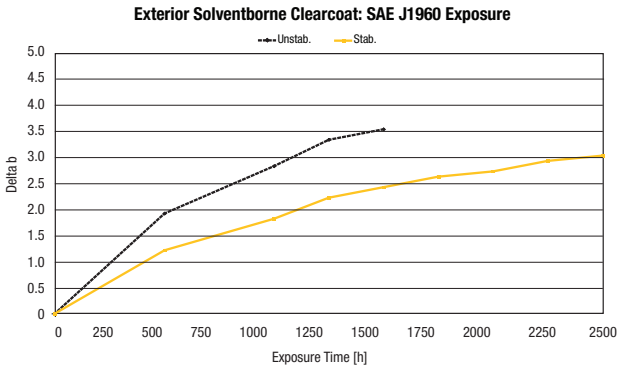


FIGURE 3: Color Change Upon Accelerated Weathering



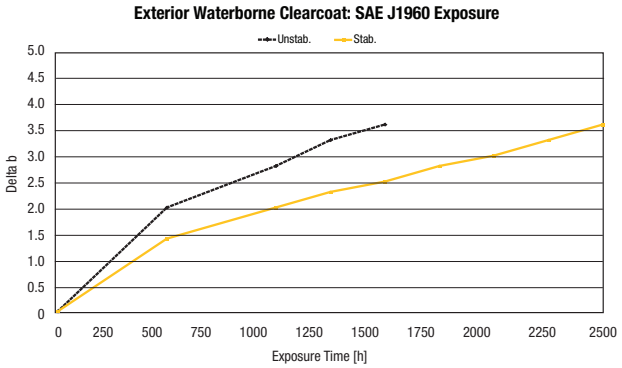
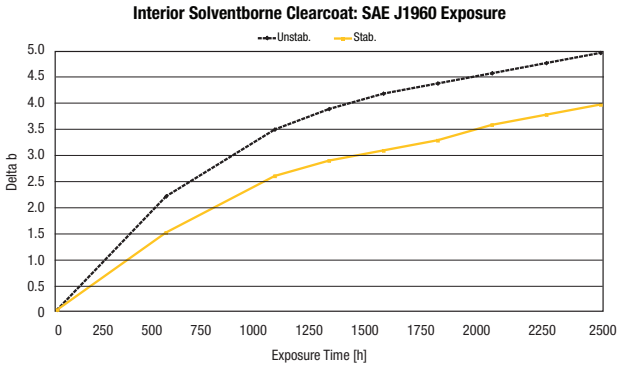


FIGURE 4: Color Change Upon Accelerated Weathering



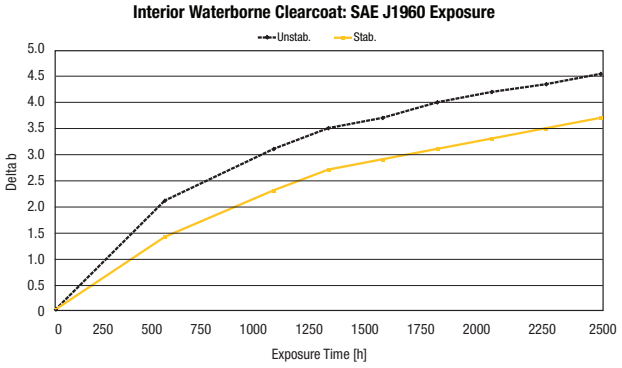
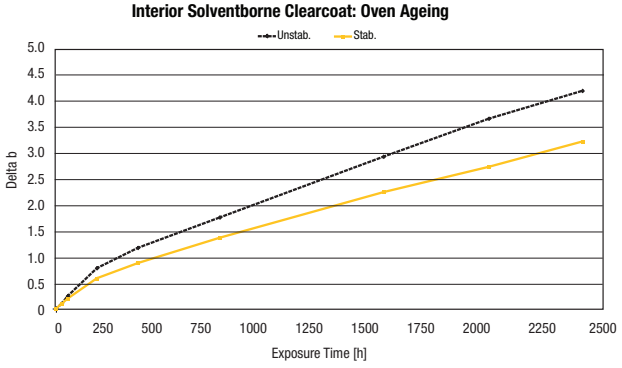
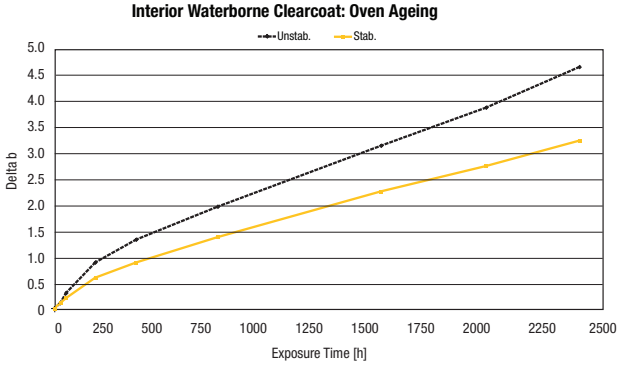


FIGURE 5: Color Change Upon Oven Ageing at 90 °C for 90 Days





aid of the metric of colors in accordance with DIN EN ISO 105-A05, DIN 6174 using a spectrophotometer CM-512m3 (Minolta). Surface properties like cracks were checked visually.

Test Results

Accelerated Weathering Exposure According to SAE J1960 on Exterior Car Part Systems

Result: Regarding gloss retention and color change, solventbornes and waterborne clearcoats behave very similarly. Only very small differences were detected.

Accelerated Weathering and Heat Exposure on Interior Car Part Systems

In contrast to exterior coatings, interior systems need more radical scavenger. The ratio in this application was 1% UV-absorber and 1.2% HALS. This is due to the fact that the hindered amine light stabilizers also act partly as thermo stabilizers and the UV-light is blocked by the glazing. The interior coatings were only checked on color change due to very low initial gloss and gloss change. The development of color change, expressed as delta b values, is given in the figures on page 6. The waterborne basecoat used in this application was white pigmented.

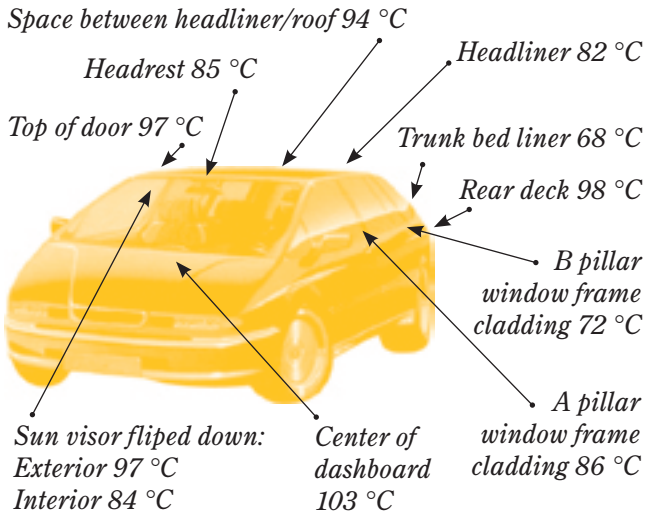
Result: Regarding gloss retention and color change, solventborne and waterborne clear coats behave very similarly. Again, just very small differences were detected.

Thermal Stabilization of Automotive Interior Coatings

The maximum heat of some parts in a car can reach temperatures above 100 °C. This is shown in Figure 6, where the maximum temperature of various materials during exposure in Arizona are indicated.

What makes the temperature rise that high? Styling trends have increased the overall glazed area in vehicles, as demonstrated by cars built in huge quantities, such as Opel Astra, Ford Fiesta and VW Golf, through their various generations (Figure 7). Today, these three models use around 20% more glass than they did 20 years ago. To avoid or reduce these high interior temperatures, new glass types were developed. Figure 8 (page 8) shows UV-VIS and infrared transmission curves of various vehicle glass types. However, this is not true for all vehicles; the big exceptions are in the growing field of convertibles, where "interior" is "exterior" at the same

FIGURE 6: Maximum Heat Distribution in an Automobile Upon Direct Sunlight Exposure



Source: P. Schwarzer et al., Atlas Technical Conference for Accelerated Ageing and Evaluation, Bad Orb, 2002

FIGURE 7
1979–2003: Increase of the windshield about 60%; increase of total glazing about 24%

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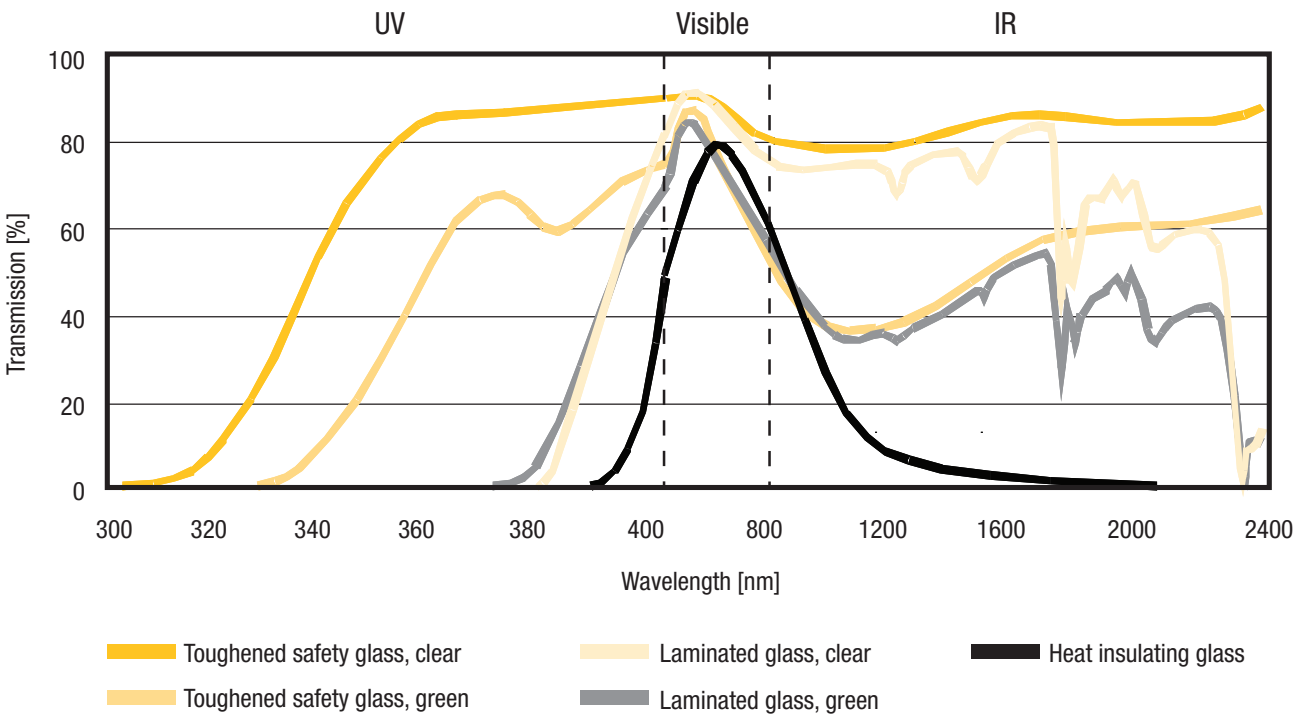
FIGURE 8: UV-VIS-IR Transmission of Different Glass Types Used in Automobile Glazing



Source: P. Schwarzer et al., Atlas Technical Conference for Accelerated Ageing and Evaluation, Bad Orb, 2002 (originally supplied by Sekurit - Saint Gobain)

time. To meet this demand as well, the coating has to be stabilized against light and thermal degradation.

Thermal Stabilization Concept

Stabilization of polymers, like polyolefines, primarily use process stabilizers and long-term heat stabilizers together at the same time. The following general classes are known:

Stabilizer Type	Main Action and Use
Hindered Amines	Mainly used as light stabilizer, radical scavenger
Sulfur Synergists	Synergist in combination with hindered phenols, smell problems can occur
Hindered Phenols	Used in basic and long term heat stabilization, o-centered radical traps
Phosphites	Used as processing stabilizer
Phosphonites	Used as processing stabilizer
Lactones	Used as co-stabilizer in processing for high temperature applications

Phenolic antioxidants are the workhorses in the polymer industry. With the broadest action window, starting at about room temperature and reaching up to 250 °C, their use seems to be almost universal.

Main criteria for the selection of suitable thermo stabilizers in coating systems, especially for car interior applications are:

- high efficiency
- migration fastness
- non fogging, no smell (low volatility)
- color stability during the stoving step and heat exposure
- no influence on storage stability of the wet paint (hydrolysis)

Figure 9 shows the antioxidants' action explained by the oxidation inhibition reactions involving sterically hindered phenols.

However, formation of intensively yellow-colored quinonoid structures is one of the main drawbacks of this type of antioxidant.

FIGURE 9: Mode of Action of Phenolic Antioxidants

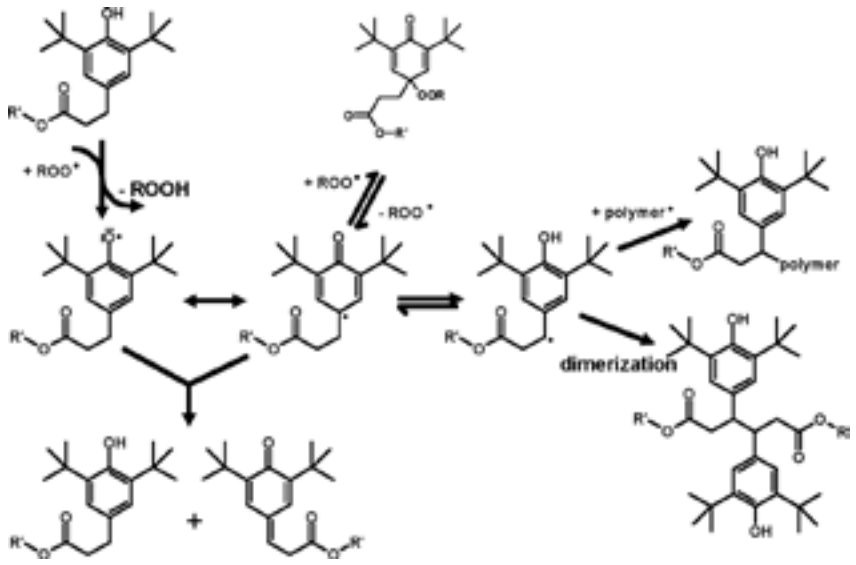
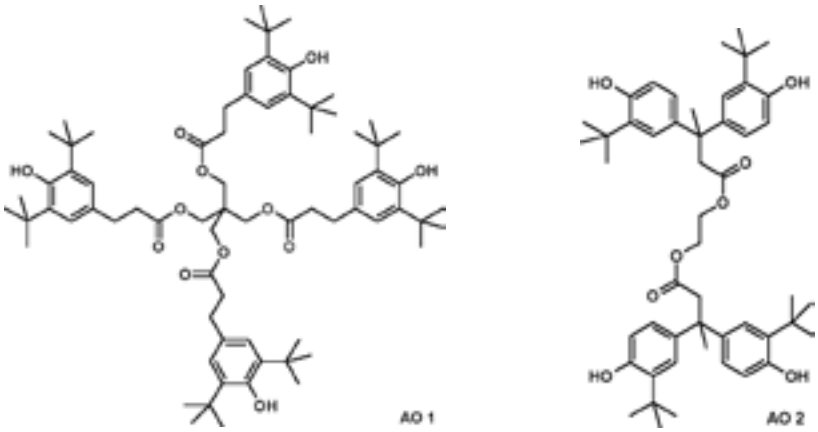


FIGURE 10: Chemical Structures of Antioxidants Used



Heat Stabilization of a Soft-Feel Clear Coat

The following two phenolic antioxidants in Figure 10 were selected and used at a level of 0.2 % in addition to the basic light-stabilization in the interior waterborne clearcoat mentioned previously. They were added as solution in a water miscible solvent. The main difference in these two selected stabilizers is in their tendency to form the yellow-colored structures previously discussed. Due to the quaternary carbon in AO 2, the formation of a full quinonoid structure as described in Figure 9 is impossible.

Some other differences besides the formation of colored quinonoid oxidation products are the hydrolytic stability and volatility behavior of these two heat stabilizers, shown in Figures 11 and 12 (page 10).

The clearcoats stabilized in this way were again applied over a white basecoat. After curing, they were exposed to artificial weathering according to SAE J1960 and in the oven at 90 °C for 90 days. The development of color change expressed as delta b values is shown in Figures 13 and 14 (page 10).

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FIGURE 11: Hydrolysis of Antioxidants

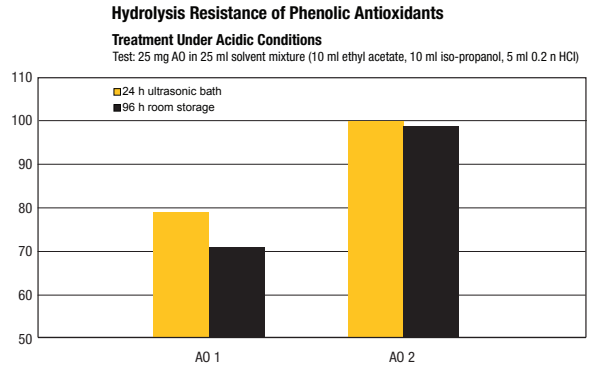


FIGURE 12: Volatility of Antioxidants

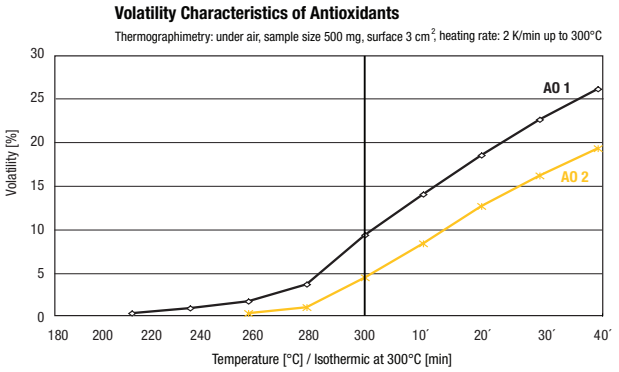


FIGURE 13: Color Change Upon Accelerated Weathering

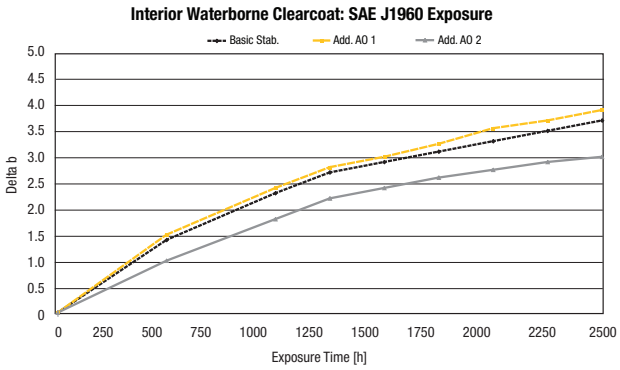
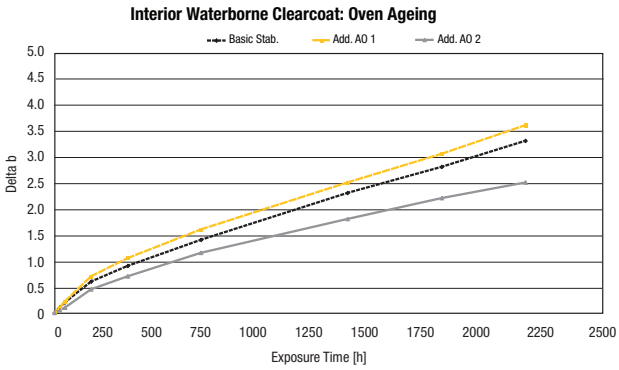


FIGURE 14:
Color Change Upon Oven Ageing at 90 °C for 90 Days



Results

It is obvious that there is an influence of the used antioxidant on the color stability of the clear coat. Whereas the addition of AO 1 has no or even a slight negative contribution to the color development compared to the "basic light stabilization," the addition of AO 2 shows a distinctive reduction in yellowing. The reduction in yellowing is one of the key advantages of AO 2, where quinonoid structures as expressed in the antioxidants action scheme are not possible. Additionally, it could be shown in another study that AO 2 is much more stable against hydrolysis than AO 1. AO 2 is thus the preferred heat stabilizer for waterborne clearcoats.

Summary

It could be shown, that a stabilizer system consisting of UV absorber and radical scavenger is good to excellent in exterior plastic coatings stabilization—both in gloss retention and color change behavior. Using the same—only light stabilization—concept in car interior (soft feel) coatings is not sufficient to fulfill all demands. The addition of a small amount of a slowly hydrolyzing phenolic antioxidant with low discoloration tendency can be advantageous in reducing the color development in heat exposed coatings significantly. ■

Additional Table

Areas of Application and Typical Properties of Important Plastics for Automobiles

Polymer Name	Acronym	Properties	Application Examples
Polypropylene	PP	Low-cost, good solidity, chemical resistance	Bumpers, wheel housings, air filter housings, guide channels, containers, side panels
Polyurethane	PUR	Damping, good elasticity, low heat conductivity	Seat upholstery, dashboard and roof padding, exterior elements
Acrylonitrile Butadiene Styrene Copolymer	ABS	Electroplatable, dimensionally stable, solid	Interior paneling, wheel panels, radiator grills
Polyamide	PA	Temperature-stable, low gas permeability, permanently solid, rigid, ageing-resistant	Motor coverings, suction elbows, wheel panels, plugs
Polyvinylchloride	PVC	Weather-resistant, low-cost, non-inflammable, good haptics	Underbody protection, protective bordering, cable insulation, interior paneling
Polyethylene	PE	Low-cost, ageing-resistant, chemical resistance, good solidity	Fuel tanks, windshield fluid containers
Polyoxy methylene	POM	Chemical resistance, abrasion-resistant, impact-resistant, low tendency to creeping, thermally stable	Clips, connectors, bearing components
Polymethylmeth-acrylate	PMMA	Transparent, scratch-resistant, UV-resistant, stress-cracking resistant	Headlight lenses for blinker and rear lamps
Polycarbonate	PC	Impact-resistant, transparent, UV-resistant	Headlight lenses, bumper coverings, exterior auto body parts
Polyethylenetere-phthalate	PET	Tensile strength, rigid, good barrier effect	Textiles, coverings, seat belts, airbags
Polybutylenetere-phthalate	PBT	Rigid, heat-resistant, good electrical insulating behavior, dimensional accuracy	Electronic housings, bumper coverings, exterior auto body parts, plugs

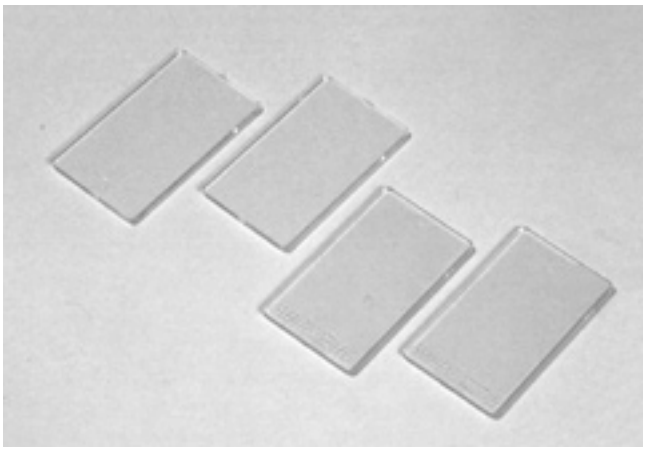
Source: Plastics in Automobiles (in German), German Association of Plastics Manufacturers (VKE)

This paper was first presented at the European Coatings Conference, "Modern Coatings for Plastics Substrates II," Berlin, November 17–18, 2005.

IFAI Automotive Materials Association Standard Reference Material Update

New Lots of Polystyrene and ORWET Available for Automotive Testing

After many months of polystyrene standard reference material (SRM) shortage, laboratories performing SAE J1885[1], J1960[2], J2412[3], and/or J2527[4] now have a new lot of SRM available for their use. The IFAI Automotive Materials Association Standard Reference Material task group has recently concluded qualification of the latest lot of polystyrene SRM for use with these automotive accelerated weathering test methods. "Polystyrene Lot 8" is now available from TestFabrics, Inc. (415 Delaware Avenue, West Pittiston, PA 18643; +1-570-603-0432).



In addition, the SRM task group has also qualified the "EMPA 840 (ORWET)" for use with the automotive test methods mentioned above. This new SRM is available as an alternative to the polystyrene chips. It is available from EMPA (Überlandstrasse 129, CH-8600 Dübendorf, Switzerland; +41-044-823-55-11).

The new tolerance ranges are included with each shipment of SRM. The original documentation is also available directly from IFAI. Unfortunately, these new tolerances have some limitations. The cover letter included with the tolerances states:

> *Previous lots of polystyrene material, lots 5 and 6, yellowed, but remained clear for the duration of the round robin test period. Lot 7 was tested but was not qualified for production. Polystyrene lot 8 developed a very slight, white haze at day 4-6 under test. While this white haze became more noticeable as the test progressed, it was deemed acceptable by the committee based on the composite round robin test results.*
>
> *In past round robin tests, existing, qualified reference materials were used to ensure that participating instruments operated in an acceptable performance range prior to beginning the "real" round robin tests. However, due to the unavailability of qualified reference materials (previous lots), this pre- qualification step was omitted for the round robin test protocol that produced the results shown in this report.*
>
> *Please note that the tolerances for this new lot of reference material are generally broader than those of previous lots. The tolerances come directly from the test results. Due to the limitations of the available data, at this time the Automotive Materials Association is unable to definitively explain the reason(s) that this round robin test produced broader tolerances.*[5]

Although hazing may be present on polystyrene reference chips after exposure, the material remains acceptable. The hazing noted during the round robin testing can be attributed to the raw material used for the chips. The original material used in prior lots is no longer available from the supplier, forcing TestFabrics, Inc. to identify a new source. Several candidate submissions were evaluated and found to be unsuitable. The final submission, although not ideal, was deemed suitable by the SRM task force.

Tests exposed in Atlas Weather-Ometers per SAE J1885/J2412 and SAE J1960/J2527 requiring Extended UV filters, should use the Atlas Quartz Inner and Borosilicate "Type S" Outer filter combination. Tests exposed in Atlas Weather-Ometers per SAE J1960 or SAE J2527 requiring Daylight filters should use the Atlas Borosilicate "Type S" Inner and Outer filter combination. ■

References

1. SAE J1885-2005 Accelerated Exposure Of Automotive Interior Trim Components Using a Controlled Irradiance Water Cooled Xenon-Arc Apparatus. SAE International Surface Vehicle Standard. Warrendale, PA: SAE International, 2005.
2. SAE J1960-2004 Accelerated Exposure of Automotive Exterior Materials Using a Controlled Irradiance Water-cooled Xenon Arc Apparatus. SAE International Surface Vehicle Standard. Warrendale, PA: SAE International, 2004.
3. SAE J2412-2004 Accelerated Exposure of Automotive Interior Trim Components Using a Controlled Irradiance Xenon-Arc Apparatus. SAE International Surface Vehicle Standard. Warrendale, PA: SAE International, 2004.
4. SAE J2527-2004 Performance Based Standard for Accelerated Exposure of Automotive Exterior Materials Using A Controlled Irradiance Xenon-Arc Apparatus. SAE International Surface Vehicle Standard. Warrendale, PA: SAE International, 2004.
5. Osman, Kristy. Cover Letter for Polystyrene Lot 8 and EMPA 840 (ORWET) Standard Reference Material. Roseville, MN: Industrial Fabrics Association International, 5 May 2006.

IFAI Expo 2006 to Feature Automotive Materials Symposium

The Automotive Materials Symposium, which will be held during IFAI Expo 2006 in Atlanta, Georgia, has been scheduled for **October 31, 2006.** The symposium will feature a full day of presentations covering such topics as New Developments in Material Trends, Advancements and Testing Trends in Automotive Materials, and Design Trends and Low Cost Alternatives.

Kurt Scott, Director of Research and Development for Atlas Material Testing Technology, will present a paper titled "Innovations in Laboratory Instruments Revolutionize Automotive Materials Weathering Tests." This paper will report on important innovations that will allow weathering instruments to conduct tests as well as characterize test conditions and specimens in unprecedented ways.

For more information about the Automotive Materials Symposium or IFAI Expo 2006, please contact Deb Stender, IFAI, at **dlstender@ifai.com**. For more information on Kurt Scott's paper presentation, please contact Kerry Quilter, Atlas Material Testing Technology, at **kquilter@atlas-mts.com**.

Atlas Test Instruments Group *continued*

Atlas Introduces Advanced Digital Control System for Ci3000+ and Ci4000 Weather-Ometers

Improved Functionality, Scalability and Ease-of-Use Meet Exacting Test Parameters

Atlas has introduced an enhanced digital control system for the Ci3000+ and Ci4000 Xenon-arc Weather-Ometers, giving operators more flexibility and control of their accelerated weathering testing.

One of the most notable changes is a modern, full color TFT touch screen display with intuitive icons for easier interpretation of operating parameters and warnings. At the heart of the upgrade is the embedded control system that replaces the PLC controller of the previous generation. Internally, analog control circuits were replaced with a robust digital network for more reliable and accurate control and monitoring of the data. Memory capacity has been significantly increased allowing for additional features and functions previously managed by external controllers, such as water resistivity and lamp water temperature. Now with a single control system, operators can be more efficient analyzing instrument performance, monitoring test parameters, and performing calibration procedures.

Among other standard features and benefits of the new control system are:

- Sub-cycle repeat programming for copying standards and saving them as templates
- Full color trend plot screen with large capacity
- Smart media card interface for test data portability
- Smart sensors that communicate their status to the touch panel at power-up
- Streaming data output formatted for compatibility with modern laboratory information management systems (LIMS).

The advanced digital control system is built with scalability for future upgrades. New software versions will simply be uploaded via the interface.

For more information about the advanced control system, please contact your sales representative at +1-773-327-4520 or info@atlas-mts.com. Visit the Atlas website at www.atlas-mts.com. ■

Atlas' UK facility accredited to DIN EN ISO/IEC 17025:2005

See page 19.

Weathering Experimenter's Toolbox: Sample Size—Never One

By Henry K. Hardcastle III

With application of statistical analysis to weathering experiments, the age-old question of appropriate sample size surfaces. Collecting answers to the "How many samples?" question has provided this author with a great deal of entertainment. Some of the answers recorded include: "At least 30," "Five if you want a warm fuzzy," "Thirty if you want to be sure," "It depends," "Ten, but they must be randomly selected," and "As many as possible given the economic constraints."

One of the reasons the sample size question is sometimes difficult to answer is that it points to a critical issue that weathering researchers must address: "Does the central research question deal with the location of a results distribution, the dispersion of a results distribution, or both?" For instance, will an additive change the mean failure time of a coating from six months to six years (a question of location), will an additive change the range of coating failure times from ± six months to ± six years (a question of dispersion), or will the coating performance with the additive be significantly different than without the additive (a question of both location and dispersion). Often, weathering researchers focus predominantly on research aspects regarding location alone (means).

The practice of exposing a sample size of one (n = 1) does not acknowledge the possibility of variation in the natural weathering process. Single sample weathering exposure submissions are based on the premise that the variation within and between the material, processing, and the environment is known and small with respect to changes observed. The confound, however, is that this premise cannot be established without submitting sample sizes greater than one! There is a quantum leap in the level of information obtained in going from a single sample to a sample size greater than one. Obviously, as sample sizes increase beyond one, the data becomes more robust and, if randomly sampled, soon becomes useful in describing the distribution of the parent population, can be applied to inferential statistical analysis, and can be transformed into a normal distribution with the central limit theorem.

To begin to answer the appropriate sample size question at its simplest level, one may understand the considerations involved by examining a simple z-test. Application of a z-test points to four basic considerations:

1. The minimum difference between two groups to be detected (e.g. a minimum difference of 5 delta L* units or 0.05 delta L* units between the test group and the control group)
2. The inherent variation in each of the two groups (e.g., $\sigma = 0.05$ or $\sigma = 0.50$)
3. The acceptable risk of saying the two groups are the same when actually they are different.

Continued on next page

AtlasCommitment to Growth *continued*

Sample Size, from previous page

4. The acceptable risk of saying the two groups are different when actually they are the same.

In summary: effect size, variance, and risk tolerance.

$$Z = \frac{(\text{mean}_1 - \text{mean}_2)}{S_p\,(1/n_1 + 1/n_2)^{1/2}}$$

Compare with Z table value AT A CONFIDENCE LEVEL

As effect size, variance, and risk tolerance change, a different sample size is dictated. As discrimination levels get smaller, n needs to increase. As variation inherent in the populations gets larger, n needs to increase. As tolerance of risk of making incorrect decisions gets smaller, n needs to increase. By back calculating from statistical tests, researchers can estimate the appropriate sample size without using "rules of thumb." These calculations require researchers to first characterize the inherent variation or dispersion in the population which, by definition, requires sample sizes greater than one. ■

Second Atlas ATCAE Gets Rave Reviews

The second Atlas Technical Conference for Accelerated Ageing and Evaluation (ATCAE), which took place at the Ile des Embiez in the south of France in May, was a great success.

More than 70 participants and 13 lecturers came to Ile des Embiez to gain insight into the latest weathering technology. Sophisticated weathering experts and material scientists from all over the world presented at the conference.

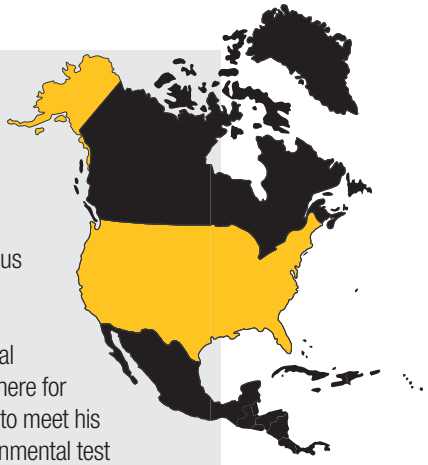
The lectures covered the entire scope of various weathering techniques as well as various field of applications. They alternated between scientific and company presentations, which focused more on applications and the correlation between outdoor and laboratory weathering. The overall focus was on the field and aging of polymer materials. Topics included the latest information on outdoor and laboratory weathering, lifetime prediction of macromolecular polymer materials, photochemistry and photostability and the correlation of testing results. The conference and discussion was moderated by Andreas Riedl, Manager Technical Standards, Product Manager Weathering Instruments, Atlas MTT GmbH.

A site tour of Sanary-sur-Mer, Atlas' European outdoor exposure site, was offered each day of the conference. More than half of the participants took advantage of the opportunity to visit the European benchmark site for the Mediterranean climate.

The conference, which was positively received by both participants and lecturers, ended with the announcement of the upcoming ATCAE conference, which is scheduled to take place in the United Kingdom in 2008.

For those who did not have the chance to participate in the ATCAE conference, there will be an opportunity to purchase the conference material on CD. If you are interested please contact Bruno Benjerodt (+49-6051-707-245 or bbentjerodt@atlasmtt.de) or Sandra Schneider (+49-6051-707-160 or sschneider@atlasmtt.de). ■

Atlas Announces New Technical Sales Representatives



Atlas is pleased to announce the addition of three Technical Sales Representatives to its team. Timothy Lederle, Harrison Smitelli, and Marty Hansen have been assigned to various territories within the United States as Atlas expands its presence in the U.S.

Timothy Lederle, an Authorized Technical Sales Representative, will serve the northwestern USA, covering Washington, Oregon, Idaho, and areas of California (for environmental chambers). Lederle formerly represented ESPEC Corp as an independent sales representative where for the last seven years he excelled at providing precise solutions and environmental test chambers to meet his customers' needs. Prior to that, Lederle represented Thermotron Industries where he sold environmental test equipment for seven years.

Harrison Smitelli, an Atlas Technical Sales Representative, will be responsible for the southeastern USA, including Georgia, South Carolina, Florida, Alabama, and Tennessee. Smitelli comes to Atlas with over 20 years of technical sales experience. Previously a representative at E.J. Brooks Co., for the last 12 years Smitelli has worked with major transportation, food, manufacturing, and utility companies to assist customers in finding solutions to their production issues. He is well versed in clients' needs for products to work in demanding applications such as super heated, corrosive, high pressure, and combustible conditions.

Marty Hansen, an Atlas Technical Sales Representative, will assist customers in the Midwest, covering Illinois, Indiana, Kentucky, Missouri, Wisconsin, Minnesota, and Iowa. Hansen has seven years of business experience and extensive sales and service training. Most recently representing Illinois Tool Works/GaleWrap, Hansen excelled at assessing client needs and providing viable solutions. Having successfully covered an eight-state territory in the Midwest, Hansen is well equipped to quickly respond to the needs of many clients across a wide region.

If you have any questions, please contact David Foy, General Manager, U.S. Sales, at dfoy@atlas-mts.com. ■

Atlas Client Education 2006

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 shorted 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

September 6
Kassel, Germany

October 10
Kortrijk, Belgium

October 12
Miami, FL, USA

November 30
Horb, Germany

Fundamentals of Weathering II

September 7
Kassel, Germany

October 5
Wien, Austria

October 11
Kortrijk, Belgium

October 13
Miami, FL, USA

October 17
Bicester, UK

XENOTEST® Workshop

Linsengericht, Germany

October 17–18

SUNTEST Workshop

Bicester, UK

October 18

Linsengericht, Germany

October 20

Weather-Ometer® Workshops

Miami, Florida, USA

October 9–10
Ci35/Ci65

October 11
Ci4000/Ci5000

Bicester, UK

October 19
General

Duisburg, Germany

October 24–25
General

For more information on courses in Europe, contact Atlas MTT GmbH, attention Bruno Bentjerodt, +49-6051-707-245 or clienteducation@atlasmtt.de.

For more information on courses in North America, contact Kerry Quilter at +1-773-327-4520 or kquilter@atlas-mts.com.

Or visit our website at www.atlas-mts.com.

Atlas Begins Testing at New Florida Headquarters

Atlas Weathering Services Group (AWSG) continues to make progress in consolidating its Florida operations and opening our new headquarters at **South Florida Test Service, 16100 SW 216th Street, Miami, FL 33170.**

As of June 15, all new orders for outdoor exposure testing in Miami are being exposed at our new headquarters. Additionally, all existing test specimens are being relocated over the next several months. As each section of the field is prepared, specimens are transported and set up in their new location. All requirements for transporting and handling specimens per ASTM G147 – Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests will be met. This process will continue until all specimens have been transferred.

"We've gone through this process several times as our business has grown over the last 75 years," notes Jack Martin, President of AWSG. "Our processes will ensure that samples be moved safely and quickly and our bar-coding system will allow us to accurately track the movement of every specimen."

For further information or to schedule a tour once the new facilities are complete, contact your customer service representative at +1-800-255-3738 or visit www.atlas-mts.com. ■

Electronic Reporting Provides Test Information Quickly, Securely

Atlas Weathering Services Group has recently introduced electronic reporting with extensive web-based access for customers to easily retrieve their test information and data.

Available at no cost to all AWSG customers, the e-services deliver password protected desktop access to real-time and historical test data. A password is automatically generated for new clients and e-mailed to their desktop along with their acknowledgment letter.

"The positive feedback from our clients has been overwhelming," says Richard Slomko, General Manager AWSG-USA. "They are thrilled with the ability to easily access secure, historical, and time-sensitive information from their desktops."

Offering convenience and time savings, the e-services include:

- **Live Test Tracking.** At any time, clients with active tests can go online and view daily radiation values and the five most recent tests completed or pending activities. This quick and easy access to real-time test progress enables clients to stay on top of their planning and forecasting.
- **e-Reporting.** Atlas automatically delivers all test reports to a client's designated e-mail. Current evaluation reports are sent in an Excel spreadsheet while all other reports are delivered in a PDF format. A valuable tool, e-reporting is a fast and convenient way for clients to stay up-to-date on the progress of their tests.
- **Historical Evaluation Reports.** The historical reporting service allows clients to obtain archived evaluation reports of their tests. Clients can easily obtain past reports through a secure area on the Atlas website. For instance, if they have misplaced the 3-month report on a 12-month exposure, they can quickly find it and print a new copy or save it to their network.

For more information about AWSG's electronic reporting, please contact your client service representative at +1-800-255-3738 or info@atlas-mts.com.

Atlas Outdoor Site Now Equipped With New Weather Station

The Atlas Material Testing Technology outdoor site in Sanary-sur-Mer, France, installed a new weather station in May. It was designed and built using Atlas' long-standing expertise in outdoor weathering technology to ensure comparable measurements to Arizona and Florida.

The new weather station will record the global solar irradiance, UV-light, black panel and black standard temperature (each at 0° and 45°) and humidity as well as wind speed and direction. The weather station is equipped with additional solar energy-powered batteries that guarantee a continuous and exact measurement, even in the event of a power breakdown.

Like the data from the weather stations in Arizona and Florida, the readings from our new weather station in Sanary-sur-Mer will be made available on our website, www.atlas-mts.com. This service, which will include the high, low, and average data for every month, will go live at the end of the year.

For further information, please contact Siegfried Roessner at our laboratory in Dusiburg (labordu@atlasmtt.de or +49-2065-76490) or Cécile Cartereau at our outdoor site in Sanary-sur-Mer (atlas.sanary@wanadoo.fr or +33-494-88-32-75). ■

Atlas Test Laboratory in the UK Accredited to DIN EN ISO/IEC 17025:2005

The test laboratory of Atlas MTT in Bicester, UK was accredited recently by Deutscher Akkredititerungsrat (DAR), an internationally renowned accreditation council affiliated with the Federal Institute for Materials Research and Testing of Germany.

The test lab in UK is part of Atlas Weathering Services Group (AWSG), one of the largest networks of ISO/IEC 17025:2005 accredited accelerated weathering testing laboratories in the world. With laboratories in the United States, France, Germany, and the UK, AWSG's indoor exposure laboratories offer artificial accelerated weathering tests and a variety of other environmental test programs, all designed to accurately simulate true end-use conditions and meet global weathering standards. All labs have proven over many years to provide reliable results to international customers.

The accreditation stresses the laboratories' obligation to identify clients' needs and ensures the test methods chosen meet those needs. The facility in the UK performs accelerated weathering and light fastness testing. Featuring a variety of xenon, carbon-arc, fluorescent, and metal halide weathering instruments, the lab can meet accelerated test methods from corporate, national, and international standards organizations.

For more information on the services offered, please contact the European AWSG offices by using the contact button on our website, **www.atlas-mts.com;** phone **+49-2065-76490;** or e-mail **labordu@atlasmtt.de.** ■

Visit us at Fakuma!

October 17–21
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To receive Sun Spots *electronically, please visit www.atlas-mts.com/newsletter*

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