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Material Testing Product and Technology News

Determination of Oxidative Stability of Materials by Chemiluminescence A New Industrial Analytical Tool*

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INTRODUCTION

The major cause of degradation of most organic materials is oxidation. Oxidation occurs under common environmental conditions such as elevated temperatures and UV-light. In the simplest form, heat causes the material to form a chemically highly reactive radical. In the case of photooxidation, such as occurs in outdoor weathering, high-energy photons cause chain scission (breakage) and the formations of highly reactive free radicals. Hydroperoxides are generated from these free radicals, which will readily decompose. The degradation processes are light (photon) emitting reactions that can be detected. Due to the fact that luminescence originates, in this case, from a chemical reaction, it is called "Chemiluminescence (CL)," often observed in the UV / visible wavelength range.

The exact mechanisms are still a matter of academic dispute, but from a pragmatic point of view, the mechanisms are generally less important when evaluating the oxidative stability (or resistance to oxidation) of organic materials.

Figure 1 CL400 ChemiLUME™

The simplicity and extreme sensitivity of the CL technique in detecting oxidation reactions at very early stages and under conditions approaching those in service[1] makes it highly interesting for industrial applications especially in quality control.

So far, the technology has not yet gained acceptance as a test method in the industrial environment, due to the fact that the low quantum yield of the chemiluminescence reactions requires highly efficient photon counting technologies. Well defined testing procedures and specified, application dependent testing conditions are still missing, as well.

* Paper presented at the 5th International Conference on Solar Energy and Applied Photochemistry (SOLAR ´99); 30 March – 4 April 1999, Cairo, Egypt.

COME SEE THE VIEEW™ !

A new analytical device from the Analytical Instruments Group at Atlas was shown at SAE and PittCon and will be featured at ACHEMA, May 22-27 in Frankfurt, Germany. VIEEW™ Digital Image Analysis System allows laboratory personnel to analyze surface structures quickly, precisely and with reproducibility.

CL EXPERIMENTAL TECHNIQUES

The CL technique is a simple analytical test for low levels of material Hydroperoxides, which are difficult to measure by other techniques especially during early stages of oxidation.

As standardized testing procedures do not yet exist in the field of CL measurements, those procedures must carefully be established for the various individual industrial applications. It may be noticed that the CL technique is under discussion in ISO/TC 35 for paints and varnishes to be standardized as an analytical test method in this field.

Thermal oxidative stability tests using CL techniques are commonly carried out in an oxidizing atmosphere (usually 100% oxygen) under stationary kinetic conditions. The light emitted is measured either as a function of time as the sample is heated isothermally or as a function of temperature as it is heated dynamically at a constant rate of increase. In the isothermal experiments the sample is usually brought to the desired temperature in an inert gas before oxygen is admitted.

In photooxidation studies the integrated CL intensity may be determined in an inert atmosphere (usually nitrogen) during either isothermal or dynamic heating of the photochemically oxidized polymer. However, tests under isothermal conditions in oxygen after photooxidation may also successfully be conducted.

CL INSTRUMENTATION

Most CL investigations in material research and development have been carried out in quite different homemade instruments. In general, an instrument should meet the requirements in both the research and industrial environment as well. But for application and acceptance in industry, an instrument must meet the following criteria:

- short testing times
- high flexibility
- simultaneous measurements
- high repeatability and reproducibility of test results
- most variable test conditions
- automatic operation
- automatic evaluation of test results
- easy handling
- preparation tool for various/variable specimens

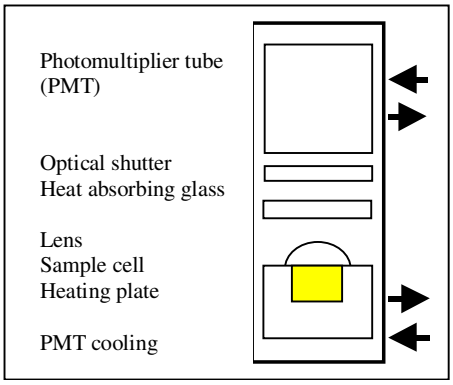


Figure 2 CL Measuring Devioce

The Atlas ChemiLUME™ CL400 is a multi-cell instrument with four independent test cells complete with:

- photon counting photomultiplier (water cooled)
- gas flow control (nitrogen and oxygen)
- isothermal and ramped tests
- test temperature control up to 250 °C
- temperature ramp rate up to 20 °C/min
- calibration kits for CL detectors and cell heating unit
- control and acquisition software

Figure 1 gives an impression of the whole CL measuring system and Figure 2 shows the design of one cell. The setup is kept as simple as possible. The substance is placed on an aluminum sample holder in the sample cell in a laminar in a weak nitrogen or oxygen flow, heated from the bottom and covered by a lens focussing the emitted light from the sample to the PMT. Between the lens and the entrance of the photomultiplier there is an optical shutter to protect the PMT from any extraneous light. The extremely sensitive water-cooled detector is sufficiently far enough away from the heating plate, as well as, protected by a heat absorbing glass. The light and temperature signals are monitored depending on preset testing conditions and CL curves may automatically or manually be analyzed during or after completion of the test.

A typical CL signal vs. time characteristic as measured in the CL400 under isothermal conditions is shown in Figure 3 (polypropylene sample–stabilized at 150 °C).

CL CHARACTERISTICS AND INFLUENCING FACTORS

The test under isothermal conditions starts with a "pretest phase" during which the sample is brought to the preset temperature usually under an inert nitrogen atmosphere.

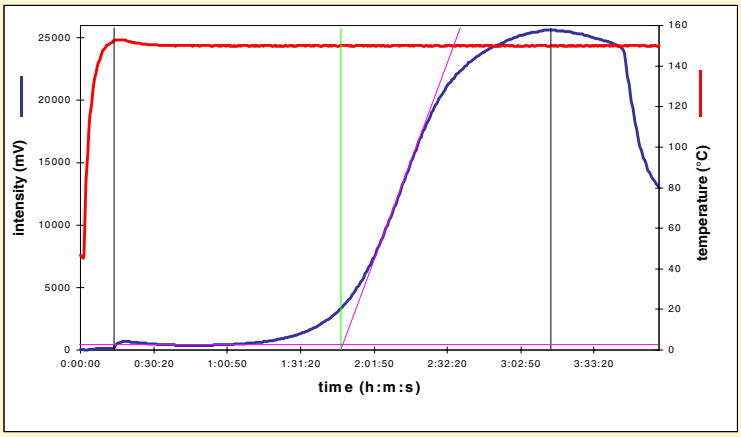


Figure 3 CL400 test result; Polypropylene (stabilized); 150 °C (isothermal)

Analysis results:

Integrated intensity in Vs
Integral low limit
Integral high limit
OIT in h:m:s*
Baseline slope in mV/s
Baseline intercept in mV*
Peak slope in mV/s
Intercept for peak slope in mV*

*** relative to test phase start**

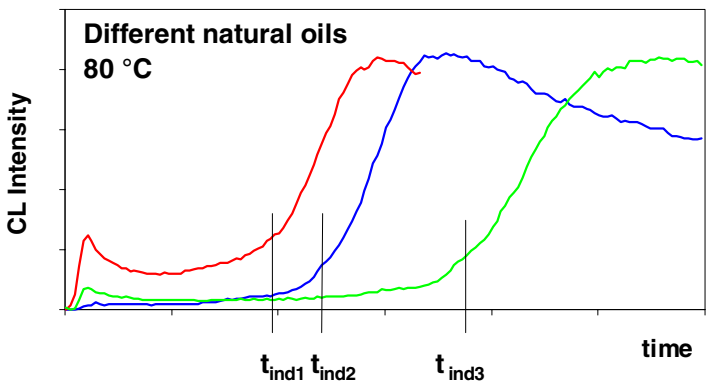
After reaching the preset temperature the gas flow is automatically switched to oxygen. As the sample begins to oxidize and reactive species are generated and decompose, photons are emitted and detected – the CL signal increases.

Under isothermal conditions two significantly different CL characteristics may be observed. Either the CL signal vs. time follows a sigmoidal (S-shaped) curve or it immediately increases after switching to oxygen. In the first case (Figure 3) there is an initial "induction period" (t_{ind} or OIT – Oxidation Induction Time[2]) during which sufficient free radicals must be generated in order for the chemical interactions to progress and the CL signal starts to rise. The time period for this induction to occur is directly related to the oxidative stability, or resistance to oxidation.

During the steadily increasing linear rise of the S-curve, one can differentiate between strong and weak oxidation by the slope or verticality of the curve. Available analysis data (see Figure 3, right hand side) based on existing theory, especially the "Oxidation Induction Time," the "integrated chemiluminescence signal," the maximum signal and the decay signal already allows a wide variety of materials to be compared with one another.

Figures 4 and 5 show two different signal characteristics. In Figure 4, several natural (unsaturated) oils have been measured under isothermal conditions. Based on similar S-shaped CL curves the oxidation induction times (t_{ind}) are significantly different, thereby demonstrating a comparison for these oils in their resistance to oxidation. Such CL measurements may be called "the classical CL or the easy way." The main requirements for the tests are a well defined fixed temperature and a careful sample preparation. The test results can be compared to conventional and established test methods such as oven aging and DSC. CL characteristics with immediately increasing intensity after switching to oxygen under isothermal conditions shown in Figure 5 – measurements on two different polyethersulfone fibers – are more complex.

The "quantitative CL or the hard way" requires quantitative evaluation of the signal characteristic – this means determination of the integrated signal.



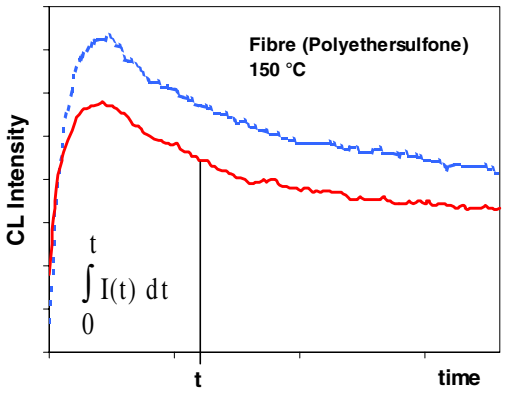


Figure 5 CL - "The Hard Way"

The signal characteristic, independent of the chemical processes, is defined by the equation:

$I = G * \phi * R$

I – CL-signal
G – Geometry term (e.g. sample, solid angle)
ϕ - Quantum yield of the detector and CL-process as well
R – Reaction rate

In the "classical CL," the geometry term remains constant during the induction period and approximately up to the maximum signal (t_{max}). The same is true for the quantum yield. Thus the signal "I" measures the reaction rate.

In the case of "quantitative CL" the geometry term may change immediately after switching to oxygen (no induction period). The quantum yield only remains constant or close to it, within a critical time space (t_{krit}). Thus, the signal "I" may not only measure the reaction rate, but (in the worst case) changes in the sample configuration during the test. As a result, the CL signal should only be integrated for the time interval below t_{krit}.

CL – REPRODUCIBILITY OF TEST RESULTS

The variability of test results is one of the most important questions and problems in material testing not only in industrial quality control. Good or at least sufficient repeatability and reproducibility of test results has to be ensured and be described in a test precision protocol.

The CL-curves in Figure 6 – isothermal CL-measurements on an unsaturated natural oil at 80 °C in two multi-sample instruments with four cells each

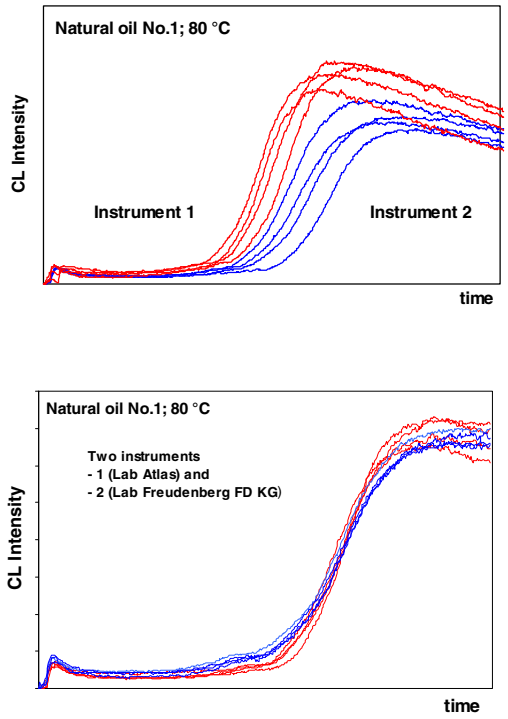


Figure 6 Reproducibility of test results

– show a rather poor reproducibility, oxidation induction time and maximum CL intensity as well. Those effects may occur from unequal distribution of stabilizer in the substance, but may also be caused by experimental inadequacies. The reproducibility can be improved by carefully calibrating the individual cells with the provided calibration tools. Beyond this there are some "critical factors" and "unexpected influences" that may alter the CL characteristics and thus influence the test results. "Critical factors" for oils and fats may be:

- exact preparation the same amount of the substance
- choosing an adequate sample holder which ensures that the light emitting surface remains constant during the test.

"Critical factors" for solid samples like films are:

- appropriate cutting techniques to avoid defects which may unsystematically enhance the active surface
- direct random contact of the sample to the heating plate during the test to avoid localized heating gradients[3].

The reproducibility of the test results can significantly be improved, as shown in Figure 7, by taking into account these critical factors.

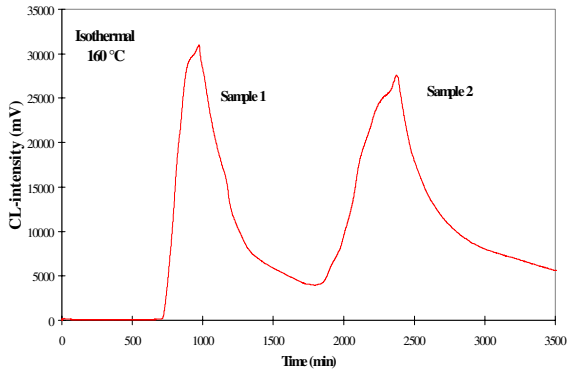


Figure 8 CL on two PP films in the same cell

CL – FLEXIBILITY IN INSTRUMENTATION

The application of the CL technique in an industrial environment requires high flexible instruments. In material quality control especially, there is often a strong demand to run various samples in a short time space. A multicell instrument allows for the simultaneous measurement of one formulation at different testing conditions or of different material formulations. Furthermore, it may also test several samples of materials with significantly different oxidative stability (e.g. formulations with different stabilization) in one cell. Figure 8 shows the test results of two differently stabilized PP-films measured simultaneously in one cell where the separated oxidation induction times may easily be calculated.

CL – EXAMPLES FOR INDUSTRIAL APPLICATIONS

There are many different industrial applications where the CL technology has already provided valuable information regarding the oxidative stability of materials[4].

The increasing durability of stabilized polymeric materials to natural environmental conditions requires specific accelerated testing procedures to gain information on the resistance to oxidation in a short time period. Artificial aging tests in weathering instruments at intensified conditions and determination of material deterioration by measurement of physical properties may last several thousand hours. Therefore, specific sensitive analytical techniques in order to assess physical and chemical changes at a very early stage of the photodegradation are necessary.

Figure 9 shows CL test results on samples of a stabilized polypropylene after exposure under accelerated conditions in a weathering instrument (conditions listed on the right hand side) at increasing time intervals for a first time period up to 18 hours. The CL tests after exposure to artificial weathering have been conducted under isothermal conditions. Thus the decreasing oxidation induction times characterize the photooxidation which has already happened by measuring the remaining thermooxidative stability. The test shows that at a very early stage significant reactions under radiation occur.

In another industrial application, the goal was to gain information on the relative resistance to photooxidation of three polyethylene films from different suppliers used for packing granulates. IR-spectra of the delivered foils did not show significant differences. Only after conducting an extended exposure to natural sunlight was it possible to roughly differentiate between the materials by IR-spectrometry.

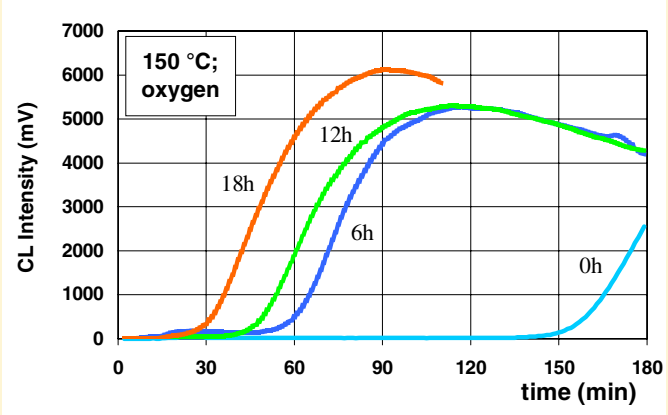


Figure 9 Influence of Preaging on thermal stability

Weathering:

Xenotest Alpha

FS Xenochrome 300

E (UV): 60 W/m²

BST: 65 °C

Rel. Hum.: 60 %

Dry/wet phase: 102/18 min

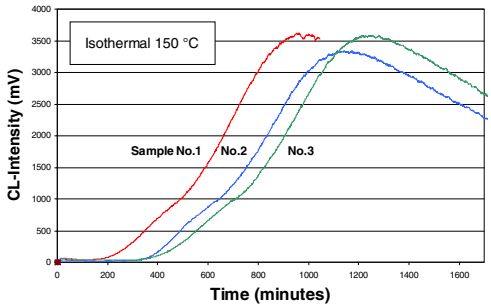


Figure 10 CL of PE Films at 150 °C

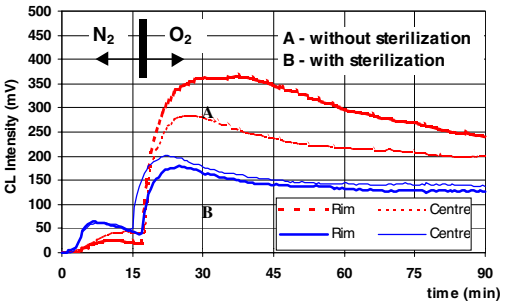


Figure 11 CL on dializer membrane elements with/without gamma sterilization

With CL measurements carried out under isothermal conditions at two temperatures (Figure 10 shows the CL curves at the higher temperature), the three materials can clearly be differentiated by evaluation of the oxidation induction times which correspond to the results from IR-spectrometry after exposure (Table 1). The ranking of the materials remains unchanged for the two test temperatures.

The test results hoped to determine whether the gamma sterilization of dialyzers might have an adverse effect on the oxidative stability of the dialyzer membrane-elements (polyethersulfone).

The CL analysis was conducted under isothermal conditions at 160 °C (Figure 11). Specimens were cut from the center and the rim of the cylindrical cross section containing the membrane elements. The CL curves of the sterilized elements show a slightly increased signal in the heating phase under nitrogen that may result from gamma induced radicals. Under oxygen the signal level of the sterilized elements is significantly reduced. The results indicate that the gamma sterilization does not decrease but improves the resistance to oxidation.

CONCLUSION

CL-technique test results on different kind of materials and material formulations confirm that the test method may provide valuable information on the relative oxidative stability of materials in a very early stage of oxidation – a fact which is especially of interest in industrial quality control.

Individual testing procedures must be carefully established and any "critical factors" have to be taken into account.

REFERENCES

[1] N.D. Searle; Atlas Sun Spots, Volume 26, Issue 52, p. 1-5. 1996

[2] ASTM D 3895 – 94; Standard Test Method for Oxidative-Induction Time of Polyolefin by Differential Scanning Calorimetry

[3] D.R. Kohler, C. Gröhnke Polymer Degradation and Stability 62 (1998), pp. 385-393

[4] J. Boxhammer, D. Kockott, D. Kohler International Workshop on Chemiluminescence; castle Smolenice; Slovak Republic; Nov. 2-5

Sample No.	IR-Spectometry Carbonyle peak at 1736.45 cm^{-1}		CL-Method OIT in hh:mm	
	New Sample	Exposed Sample	New Sample	
			150 °C	120 °C
1	none	high	06:48	85:00
2	none	mean	08:54	148:00
3	none	mean	10:26	>160

Table 1 Determination of relative oxicative stability (Exposure to natural sunlight; 480 hours)

THE ATLAS COMMITMENT TO GROWTH

Atlas Increases Support of Polymer Evaluation Products

Atlas is pleased to announce the addition of Empire Technologies, Inc. as an authorized service and sales representative for our polymer evaluations products (PEP) in the United States.

With major facilities in Houston, Texas and Boston, Massachusetts, Empire provides coverage nationwide and local presence in the major plastics research, production and processing centers for the Texas-Louisiana Gulf Coast and the Northeast area.

The Atlas – Empire partnership provides the Polymer Evaluations Products division with the ability to offer preventative maintenance and ISO Guide 25 field calibrations. A2LA accredited calibration services are a requirement of QS 9000 and Six Sigma laboratories. These services are now available to PEP instruments for melt flow, tensile, HDT/Vicat, pendulum and falling weight impact and flammability. Also included are the specimen preparation instruments such as automatic sample notchers, laboratory mixing molder and extruder and compression molding press. Empire can also provide service and calibrations on non-Atlas instruments within their scope of accreditation.

For information about the Atlas – Empire partnership, please contact Mark Chomiczewski, General Manager National Sales at (773) 327-4520. Empire can be reached directly at:

Empire Technologies, Inc.
165 L New Boston Street
Woburn, MA 01801
Phone: (781) 932-1633, Fax: (781) 932-9853

or

15885 Memorial, Suite 507
Houston, Texas 77079
Phone: (281) 558-6662, Fax: (281) 558-6686.

ATLAS TEST INSTRUMENTS GROUP

Pinpoint Accuracy at the Impact Point

Advanced Pendulum Impact Tester

Atlas is excited to announce a new Polymer Evaluation product. Created for the global market, the Atlas *Advanced Pendulum Impact Tester* (API) determines the absorbed impact energy and the resistance to breakage by impact with a pendulum and striker of notched and un-notched plastic and composite specimens. The API is engineered for the highest accuracy, precision, repeatability and reproducibility attainable in these tests.

The new API meets or exceeds all significant ISO and ASTM performance requirements for testing plastics and composites. A built-in microcomputer automatically guides the user through calibration and test setups that automatically conform to standards requirements for each test configuration. An easy to read four line screen displays test results for up to ten specimens. Details include specimen dimensions, release and absorbed energy, mean, standard deviation and variance of specimen impact. Parameters and results may be exported through the serial port to a

Charpy Test Accessories

printer or LIMS system. Both the single swing ASTM and multi-swing ISO friction loss calibrations are supported, as are custom setups.

The unique "universal" fixture design easily adapts to all Izod and Charpy configurations and specimen types, including ISO 179 Type 2 & 3, with minimal hardware changes. It also easily adapts to custom specimen fixtures. A high mass "classical" pendulum design minimizes energy loss from vibration and concentrates the energy at the impact point for the most accurate test results.

Easy to change weight and pendulum designs provide wide energy range coverage with minimal hardware changes to simplify configuration conversion and hardware investment. Pendulums and added weights are precision engineered to surpass current and anticipated future standards requirements. The API also features a heavy-duty steel construction for maximum test precision and long term reliability.

The API's advanced electrical braking system provides variable starting angle pendulum positioning for proper pendulum energy and velocity, pendulum catch-and-hold to prevent specimen double strikes and aids in safely returning the pendulum to a free hanging position. An optional instrumented Izod vise allows setting the sample clamping force, even with the cold box closed, and is displayed on the controller screen. The stainless steel, split-box construction for low temperature testing uses liquid CO_2 and liquid N_2 to reach temperatures from -50°C to -60°C.

Atlas Introduces New A3 Sample Notching Tool

To complement the API, a new high performance companion instrument, the A3 (*advanced, automated, accurate)* Notching Tool for specimen preparation is also newly introduced. The machining quality of the notch is the single most critical element in notched Izod and Charpy testing, and reducing notch errors (accuracy, precision and reproducibility) directly influences test results. Improved notches are an important element in taking advantage of the API's extended high performance.

The A3 is actually a miniature digitally controlled CNC precision milling machine designed specifically for plastic materials sample preparation. The A3 surpasses all other commercial sample notchers in precision and accuracy.

The A3 and API combination brings a new level of precision, accuracy and reproducibility to pendulum impact testing. The combination was developed with input with Six Sigma, QS 9000 and other laboratories demanding quality of results beyond those currently attainable, and was designed to meet anticipated future revisions to current global test standards.

The A3 features a precision semiautomatic calibration system for highest accuracy. The A3 is easily programmed from the touch-screen control and display panel to perform single-pass or multi-pass incremental cutting of the specimens. The absolute zero-positioning feature assures the correct depth remaining below the notch, a critical parameter. High speed tool steel or carbide cutters provide correct notch geometry and program control over cutting depth, cutter speed and specimen table feed rate allow optimization for a wide range of sample materials in up to 50 user-defined cutting programs.

Additional features include automatic chip vacuuming and automatic cutting of the notched Izod or Charpy specimen bars from the ISO universal dumbbell-shaped test specimens prior to notching. As a package the API and A3 Notcher provide a high performance, high quality unit offering Six Sigma and QS 9000 quality for research and development.

For more information about the API or the A3 please check the corresponding box on the reply card or contact your local representative.

Atlas Introduces the ViSTA6™ Heat Distortion Tester

Atlas announces another new Polymer Evaluation product. The all new ViSTA6™ heat deflection under load/Vicat softening point (HDT/Vicat) testers add to the company's widely used HDV line of three models, the HDV1, HDV2 and HDV3. These systems measure the physical performance of plastics specimens under conditions of load to applied heat stress which are important material specification and selection parameters.

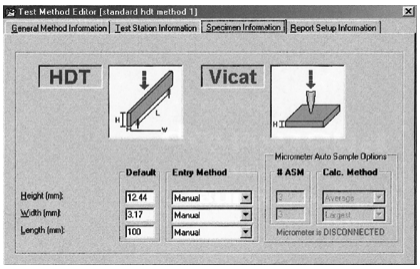
All models comply with the applicable ISO 75, ISO 306, ASTM D648 and ASTM D1525 test standards.

The ViSTA6 has been developed in close cooperation with major global resin producers to include features to meet the testing needs of high-volume quality laboratories typical of polyolefin producers. Both the instrument hardware and PC-based *Vortex* software were designed for high sample throughput, increased automation, ease of calibration and operation and offer more data output and custom report options.

The ViSTA6 features a high-volume immersion bath and dual-stirrer design for superb temperature uniformity. A pneumatic lift system semiautomatically raises and lowers the test stations platform into the bath. Combined with quickset LVDT transducer positioning, this provides for fast and easy sample loading and test setup by the average technician. Built-in twin water-cooling coils provide rapid cool-down for quick sample turnaround time; compressed air automatically clears the coils of water during temperature ramping.

The ViSTA6 features new Vortex™ PC-based Windows software for instrument operation and data acquisition. The *Methods Editor* window allows users to access four main areas:

- The *General Information* section includes selection from ISO or ASTM test methods and units of measurement, etc.
- *Test Station Information* selects the applied stress and contains other test station defaults and details.
- *Specimen Information* contains information on specimen dimensions. Exact measurements may be manually keyed in or generic default dimensions



Screenshot of the Vortex Software

selected. A third option is automatic entry when interfaced to an optional Mitutoyo micrometer.
- The *Report Setup Information* allows grouping test stations for statistical calculations and report formatting options including header and user logo.
- The *Test a Sample* screen selects from predefined test setups provides final editing of test parameters and sample information. *Security* functions include password protection from changing calibration or test conditions.

Both the ViSTA6 and HDV3 Heat Distortion Testers are designed for quality and research use and may be used in either primary role. The HDV1 is a non-PC-based system designed for the low volume laboratory. The HDV3 utilizes unique test station materials and design, which provides sophisticated frame distortion calibration corrections. This results in unmatched precision, accuracy and reproducibility at the higher temperatures required for engineering resins. A high efficiency cooling system is optional for faster cycle time from high temperature testing. For research applications the HDV3 offers the resolution needed to discriminate among samples, while the ViSTA6 provides hardware and software features oriented to the higher volume, repetitive testing needs of quality control. The HDV3 is available in 2,3,4,5 and 6-station versions, the ViSTA6 in 3 and 6 stations.

Features of ViSTA6 and HDV3 models include test station calibration and correction features; calculation of added weights to deliver the precise loading force based on actual specimen dimensions; the ability to graphically display and plot the entire deflection/penetration curves; combine ASTM and ISO specimens in the same test run and easily change from HDT to Vicat testing. High-resolution LVDT measurement transducers and low mass fast response temperature probes provide highly precise, accurate and reproducible measurements. Contact your Atlas sales representative for more information on deciding which Atlas system is right for you.

Atlas Introduces Two More Polymer Evaluation Products

The Atlas Strograph ES and EL Tensile (and compression) Testers are stand-alone benchtop instruments designed for testing most plastics (up to 500N force).

Strograph E-L

Two models are available: the ES is for standard specimens and the EL for specimens of high elongation. Both models feature a robust, cast-metal base for stability, precision ball-screw drive mechanisms, and clear, easy keyboard settings and displays. Analog chart recorder outputs are provided for stress/strain curves; an RS-232C port is also provided although the unit is designed for operation without a PC. A variety of grips and a range of load cells are available.

The Mini Test Press is a benchtop, 10-ton manual hydraulic compression molding press. The Mini Test Press features 200 x 200mm or 250 x 250mm platens, with independent autotuning PID temperature control to 300°C or 400°C. In addition to compression molding, the press can be used for rubber vulcanizing.

An optional swing-away water-cooled platen system provides compressive heating, transfers of the specimen in between the water-cooling plates and returns for cooling while under compression. The two-speed automatic switching hydraulic system provides for quick closing and easy, precise compressive force adjustment. The Mini Test Press is now available for delivery in non-CE models.

For more information about the Strograph or the Mini Test Press, please check the corresponding box on the reply card.

Mini Test Press

ATLAS SPEAKS

1st Annual Confrence of the Society of Environmental Simulation
March 29-31
Pfinztal, Germany

Dr. Jörg Boxhammer, ATLAS Material Testing Technology, will present "Registration, Simulation and Measuring of Environmental Influences." The lecture will discuss shorter test periods during thermal aging of polymers related to sunlight by using increased test conditions in weathering test instruments.

Symposium at the Technische Akademie
April 11-12
Wuppertal, Germany

Dr. Jörg Boxhamer will present "Natural and Accelerated Weathering of Polymer Materials." Dr. Boxhammer will discuss surface temperature in general and temperatur measuring technology at exposed sample levels when running accelerated light and weatherfastness tests.

Dr. Dieter Kockott, Technical Consultant to ATLAS Material Testing Technology, will also present "Natural and Accelerated Weathering of Polymer Materials," a lecture on spectral sensitivity and activation spectrums of polymers.

Symposium at the Technische Akademie
May 18-19
Wuppertal, Germany

Dr. Jörg Boxhammer will present "Measuring and Testing of Coated Surfaces." He will discuss the evaluation of the aging behavior of coatings caused by outdoor and accelerated weathering.

Atlas Releases SmartDAQ™

Are you looking for an intelligent way to manage and record data from a single or from a multiple Atlas instruments in a single network? The answer is SmartDAQ™. SmartDAQ™ is an easy to use and easy to install software program that brings the future of data management to your lab. The software can be used with the Atlas Ci3000+, Ci4000, Ci5000 Xenon Arc Weather-Ometers® and the XENOTEST® Alpha and Beta instruments.

SmartDAQ™ monitors and records data from up to eight instruments in a single network. With the use of an optional recorder, operators may record data from up to sixteen instruments. The instruments are connected with proprietary hardware in a RS-485 communications network extending from the RS-232 serial port of an IBM-compatible PC.

The software program provides centralized control of instrument status monitoring, test data logging and data file manipulation. Operators can access vivid graphical displays of instrument operations, test status and calibrated lamp status, and current and historical trend plots of test variables. The software displays scheduled stops status and error message history. Data files can be exported to Microsoft® Excel. Data reports include parameter averages and standard deviation.

SmartDAQ™ is designed to run under Microsoft Windows 95/98 or Windows NT 4.0 operating systems. A Pentium® processor or faster with 13 MB of available hard disk space is needed, as well as, a SVGA graphics display (monitor) and CD-ROM Drive.

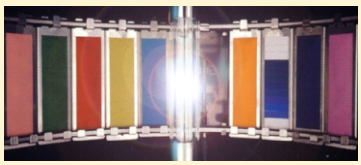
For more information about SmartDAQ™ please check the corresponding box on the reply card.

New Launder-Ometer® Supply Package

Atlas now offers a Supply Package for conducting colorfastness tests in the Launder-Ometer to assure easy start up. The package contains one 275 gm (9.75 oz) container of 1993 AATCC Standard Reference Detergent WOB (without fluorescent whitening agent and without phosphate), 500 pieces of 50 x 50 mm (2 x 2 in) Multifiber and 500 white specimen mounting cards. With this package, you can begin your testing immediately when you receive your new Launder-Ometer and supply package.

The supply package is sufficient for approximately 500 test specimens, or 25 tests in a full Launder-Ometer, filled with 20 specimen containers. Tests can be performed to meet *AATCC 61* and *ISO 105 C06*. The AATCC Chromatic Transference Scale, Gray Scale for Color Change, Gray Scale for Staining, Multifiber, specimen mounting cards and a 1350 gm (80 oz) container of the AATCC Detergent are also available separately from Atlas.

For more information about the new supply package please contact Katie Novello, Textile Product Specialist at 773-327-4520 or knovello@atlas-mts.com.



When was the last time you had your instruments calibrated? Have you calibrated your lamp recently?

For information about calibration services, please contact **Customer Service** at (773) 327-4520.

ATLAS WEATHERING SERVICES GROUP

IP/DP Box® Testing for Automotive Interiors

Atlas Weathering Services Group (AWSG) offers IP/DP (Instrument Panel/Door Panel) Box® testing, an under glass weathering method for determining the durability and/or colorfastness of materials used in automotive interiors.

Available at AWSG's DSET Laboratories site in Phoenix, Arizona and at South Florida Test Service in Miami, Florida, the IP/DP Box® is designed to test nonstandard specimen sizes such as complete door panels, instrument panels, seat cushions, and glove boxes, as well as standard 10 x 15 cm (4 x 6 in) samples. Clear laminated, clear tempered, tinted tempered and other types of glazing may be installed as specified by the governing standard or client requirements for evaluating the effects of different glazing types on interior material durability. Specimens may be exposed parallel to the glazing or at the "in service" position (e.g. door panels) as required by the applicable standard. All visual and instrumental evaluation services required by the OEMs and their suppliers are available at AWSG.

The IP/DP Box® features azimuth tracking of the sun, with the glass surface inclined at either 45° or 51° from the horizontal, exposing samples to 1.3 times the total solar irradiance of a fixed 45° angle box. Fixed 45° angle testing is available, as well, for certain test methods.

A microprocessor-controlled linear axial fan directs uniform airflow over the test specimen inside the box to ensure temperature uniformity. The fan is activated when the control temperature reaches the set point and shuts down when the temperature reaches within 3°C (5°F) of the set point. The temperature is measured by a thermocouple on the back surface of a reference black panel, with an adjacent thermocouple for monitoring purposes. Should the maximum temperature exceed 6°C over the specified temperature limit, a cover is automatically deployed to prevent further exposure until the cause of the over-temperature has been corrected.

IP/DP Box

A data logging system continuously monitors black panel temperature and can also monitor thermocouples afixed to samples for evaluating interior temperatures of materials or components. Color and gloss measurements and visual inspections are performed at scheduled intervals according to applicable test standards by AWSG's full service evaluations laboratory.

The IP/DP Box® meets the performance and approval requirements of GM 9538P and Ford DVM 0020.

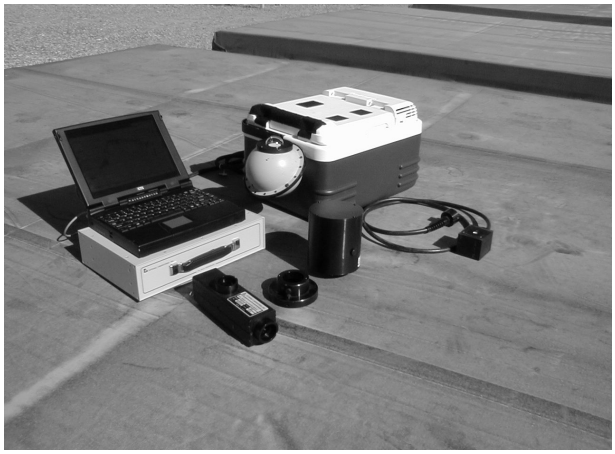
For more information about the IP/DP Box, please check the corresponding box on the reply card.

Spectral Measurements and Radiometer Calibrations available from AWSG

DSET Laboratories is now offering a new spectral measurement service using their Optronic Laboratories Model OL-754 UV-VIS Spectroradiometer. This compact and portable spectroradiometer is capable of making highly accurate spectroradiometric measurements in the laboratory or in the field. The OL-754's innovative design combines a compact optimized double monochromator with a separate controller that houses all the data acquisition and control electronics. The spectroradiometer system can be configured to make fast and accurate measurements of spectral irradiance, radiance, transmittance or reflectance over the 200 to 800 nm wavelength range.

DSET's spectroradiometer features the following:

- A compact, high efficiency double monochromator



with dual concave holographic gratings optimized for the UV spectral region

- A high sensitivity, temperature stabilized, S20 response photomultiplier tube
- Automated second order blocking filter wheel and shutter
- A six-inch PTFE coated integrating sphere with near ideal cosine response for spectral irradiance measurements of the most demanding light sources
- A newly designed small two-inch PTFE coated integrating sphere for limited accessibility measurement locations
- A quartz fiber optics probe to allow positioning of either integrating sphere up to two meters away from the optics head
- A controller which consists of a 32-bit microprocessor and associated electronics for data acquisition and monochromator control, signal processing and interfacing entirely computer controlled
- A laptop computer connected to the controller for program control and measurement storage
- A collimating tube that is mounted on the integrating sphere that allows the direct measurement of the spectral energy of only the sun's disk
- Plug-in standards of spectral irradiance with pre-aligned tungsten-halogen lamps
- A programmable, microprocessor controlled, precision DC current source (+/-0.01% current accuracy)

During the past year, DSET personnel have made approximately 800 hemispherical and direct UV-visible spectral measurements. Most of these measurements were made in the field to help characterize and determine the spectral energy distribution at all three of Atlas's weathering sites, and to measure the spectrum of transmitted sunlight in automobile cockpits and under-glass test structures. Also, many of these measurements were performed as DSET's primary reference instrument for the calibration of ultraviolet radiometers of all types. These spectral irradiance measurements are traceable to primary standards of irradiance maintained by the National Institute of Standards and Technology (NIST).

DSET's Radiometry and Calibration department has been making spectroradiometer measurements of various light sources for over 20 years. DSET can provide the following UV-visible spectral measurement services:

- On-site at your location hemispherical and direct UV-visible solar spectral irradiance distribution
- UV-A, UV-B and Visible spectral energy distribution of various light sources
- Calibration of ultraviolet radiometers of all types
- Spectral transmittance in vehicle interiors
- Spectral transmittance of building window systems and under-glass test structures
- Spectral reflectance from various surfaces
- Spectral measurements of solar simulators
- Spectral mapping of environmental/growth chambers

For more information, please contact Jerry Maybee, manager of DSET's Radiometry and Calibration department by e-mail: jmaybee@atlaswsg.com or by phone (623) 465-7356 or toll free at 1-800-255-DSET (3738).

ONE YEAR FREE!

Buy any Atlas xenon weathering instrument, Suntest XLS/XLS+ or larger, and receive one free year (12 months) of static weathering for 24 specimens. Samples or specimens can be any size up to 305 x 305 cm (12 x 12 in). Clients are responsible for all shipping and handling fees to the test site. AWSG will pay the return shipping. No third party specimens will be accepted. Please contact your Atlas Sales Representative for your complimentary static exposure entry form.

*Offer subject to change without notice. Evaluation services are not included, but are available for a fee.

ATLAS MATERIAL TESTING TECHNOLOGY GmbH

Quickwash Plus *Approved* By Marks & Spencer

The revolutionary system designed to reduce testing from hours to minutes has now been approved by Marks & Spencer plc.

As consumer attitudes harden regarding the adequacy of garments, shrinkage becomes a critical performance criterion. Textile finishers have to undergo time and cost extensive testing to satisfy customer demand on high quality materials. Shrinkage has to be tested in several home laundering washings and tumbler drying procedures requiring hours to obtain meaningful results. The short process time for the Quickwash Plus™ allows necessary corrections to be made during the finishing processes before the garment production will start. Thus companies avoid the risk of costly customer complaints.

After extensive evaluation, Marks & Spencer plc. has approved the Quickwash Plus™ system EC 300 for use by their supplier base to determine the shrinkage of weft knit fabrics. The use of the Quickwash Plus™ will reduce the testing time from an eight hour test to a one hour test allowing the suppliers to perform more process checking and improve delivery times. Marks & Spencer plc. is always alert to new test methods and quickly recognized the potential of the Quickwash Plus™ to revolutionize the way in which both independent test houses and manufacturers carry out testing. Suppliers to Marks & Spencer also benefit from the cost savings the Quickwash Plus™ offers.

As a result of the evaluation, Marks & Spencer has developed exclusive, customized programs. Already, a number of their suppliers have started to work with the instrument. Besides the new Marks & Spencer Method of Test P1D "Investigative Method of Test Quickwash stability washes for weft knitted fabrics," the Quickwash Plus™ already has a number of approvals from leading USA retailers and is now widely used in 26 countries. The recently issued AATCC 187 – 2000 specifies Quickwash as the preferred equipment.

For more information regarding the Quickwash Plus™ please check the corresponding box on the reply card.

THE ATLAS COMMITMENT TO EDUCATION

Atlas Furthers Education With New Course

Atlas is pleased to offer a new Client Education course devoted solely to weathering. The Fundamentals of Weathering II is an advanced level, one-day seminar based on the original Fundamentals of Weathering course that emphasizes lightfastness and weathering durability testing techniques. Due to popular demand, we will offer this course at various locations across the United States and Canada.

The Fundamentals of Weathering II will further examine how various factors of weather and climate, such as solar radiation, heat and moisture may affect materials, and how to test the resistance of a formulation or product to those factors. Measuring devices for light, moisture, and temperature will be identified, along with some of the common errors associated with their use. The course will examine the way advanced laboratory instruments control irradiance, humidity, and temperature. Visual and instrumental evaluation methods will be discussed for both appearance and physical attributes. Special attention will be given to testing techniques for paints and protective coatings, automotive materials, architectural building products, molded plastics, and textile materials.

Students attending the Fundamentals of Weathering II will learn more about the primary weather factors that affect the durability of materials. They will acquire an in-depth understanding of how to properly structure a weathering test to derive maximum value. From choosing the appropriate test, to analysis and evaluation techniques, students will leave the class with insightful and useful knowledge of the weathering process.

The Fundamentals of Weathering II staff includes experts from Atlas Electric Devices Company and the Atlas Weathering Services Group. Atlas Electric Devices Co. offers a complete line of physical and materials testing instrumentation including weathering lightfastness and corrosion instruments, polymer evaluation products, textile testing products, flammability chambers and analytical instruments.

Atlas Weathering Services Group (AWSG) test sites include DSET Laboratories in Phoenix, Arizona and South Florida Test Service in Miami, Florida, as well as 19 outdoor exposure sites around the world. AWSG offers a variety of climates for outdoor exposure testing including: desert, sub-tropical, high altitude, corrosive and European-standard environments. AWSG also operates a fully accredited accelerated laboratory. AWSG is ISO/IEC Guide 25 accredited.

Tuition for the seminar is $195.00 per person and includes a continental breakfast, lunch, refreshments and all course materials. Due to limited space for each seminar, advance registration is required. A 10% discount will be given to students attending both the Fundamentals of Weathering I and II courses. Schedules for the Fundamentals of Weathering II are available on the Atlas web site **www.atlas-mts.com.** Electronic registration is also available.

2000 Fundamentals of Weathering II Dates

- June 27 Marlborough, MA
- July 18 Pittsburgh, PA
- September 26 Philadelphia, PA
- October 10 Plymouth, MI
- December 5 Phoenix, AZ

2000 Fundamentals of Weathering I Dates

- April 10-14 Sâo Paulo, Brazil
- June 22 Parsippany, NJ
- June 26 Marlborough, MA
- July 17 Pittsburgh, PA
- July 20 Cincinnati, OH
- August 7 Mexico City, Mexico
- August 9 Guadalajara, Mexico
- August 11 Monterrey, Mexico
- September 21 Chicago, IL
- September 25 Philadelphia, PA
- September 28 Indianapolis, IN
- October 9 Plymouth, MI
- October 12 Arlington, TX
- October 17 Atlanta, GA
- December 4 Phoenix, AZ
- December 8 Vancouver, BC

Weather-Ometer® Workshop Moves to Miami

As of January 1, 2000, all Atlas Weather-Ometer® Workshops are being held at South Florida Test Service (SFTS) site located in Miami, Florida. Workshops will be held in the SFTS ISO Guide 25 accredited accelerated laboratory. Attendees will benefit from the move in a number of ways.

A valuable lesson in all Atlas Client Education classes is that validation tests of all Weather- Ometer® results should be performed. To do so, samples should be exposed at one of the "benchmark" climates in the US, either Phoenix, Arizona or Miami, Florida. By having the workshop at SFTS, attendees will get a first-hand look at the exposure services that the Atlas Weathering Services Group (AWSG) can provide. A tour of the SFTS facility will be added to all workshops.

Students will also benefit by having class in a fully functioning laboratory. Previously, only one or two of the newest generation Weather-Ometers® were brought to the workshop. With the relocation to the SFTS lab, students will get the chance to see many different generations of instruments that employ a variety of light sources. Now, no matter what instrument you have in your laboratory, all aspects of the class will remain relevant. A wider variety of instruments and topics can now be discussed.

In addition, classes will be limited to 15 students, creating a better trainer to student ratio than in the past. Instructors for the course will be Matt McGreer, General Manager Client Education, and representatives from AWSG, who use these instruments during the course of their daily work.

For more information about The Atlas Weather-Ometer® Workshops, please check the corresponding box on the reply card.

FREE OFFER!!

Effective as of January 1, 2000, Atlas will offer one free admission to our Weather-Ometer Workshop with the purchase of a Ci4000 or Ci5000 Xenon Arc Weather-Ometer. Customers purchasing a Ci3000+ Xenon Arc Weather-Ometer will receive a free Weather-Ometer Workshop manual.

The free admission offer includes all course materials, continental breakfast, lunch and refreshments. Accomodations and travel expenses are not include. The offer is available globally to all Atlas clients. Please visit the Atlas web site at **www.atlas-mts.com** to find your local sales representative.

2000 Weather-Ometer® Schedule

The Weather-Ometer Workshop

March	9-10
May	9-10
November	16-17

Advanced Ci35 & Ci65 Workshop

May	11

Ci4000/Ci5000 Workshop

March	8
May	8
November	15

ASNAW
The Atlas School for Natural and Accelerated Weathering

The Atlas School for Natural and Accelerated Weathering (ASNAW) offers faculty and colleagues the opportunity to gather in a relaxed environment and exchange theories on weathering practices. This advanced level symposium teaches the fundamentals of natural and accelerated weathering with primary focus on the individual and synergistic effects of various climatological elements on the degradation of materials. Test design and techniques of natural and accelerated weathering are discussed in addition to material evaluation, correlation of results, and conformance to government and industry test specifications.

ASNAW is beneficial to anyone involved in materials durability and weatherability testing, including engineers, product managers, quality control personnel and others who need to stay abreast of the latest technological and scientific developments in the field.

The 2000 Atlas School for Natural and Accelerated Weathering (ASNAW) will be held twice this year: May 3-5 at Don Shula's Hotel and Golf Resort in Miami, Florida, and October 25-27 at the Embassy Suites in Phoenix, Arizona. The seminar in Phoenix will focus on materials durability and weathering relating to the automotive industry. Guest speakers will cover new testing and modeling techniques on automotive products, service life predictions, spectroradiometry studies, and advanced evaluation of materials.

ATLAS SHOWS

ANALYTICA
April 11-14
Booth #437, Hall B5
Munich, Germany

INSTRURAMA
April 25-28
Brussels, Belgium

Apparel Sourcing Show
May 3-5
Guatemala City, Guatemala

ANTEC 2000
May 7-11
Booth #923 & 925
Orlando World Center Marriott
Orlando, Florida

PLAST
May 8-13
Milano, Italy

FEIMAFE Mechanical Fair
May 8-13
Sâo Paulo, Brazil

Materials Testing 2000
May 9-11
Birmingham, England

Waterborne Coatings: Sink or Swim 2000
May 18-19
Cleveland Airport Marriott
Cleveland, Ohio

ACHEMA
May 22-27
Booth #C-23, Hall 6.1
Frankfurt, Germany

TEXCHEM
June 1-4
Istanbul, Turkey

Poznan International Exhibition
June 12-16
Poznan, Poland

NPE 2000
June 19-23
Booth #1214
McCormick Place
Chicago, Illinois

Materials Research Congress
August 27-31
Cancun, Mexico

PLAST Imagin
September 5-8
Mexico City, Mexico

AATCC 2000
September 17-20
Benton Convention Center
Winston-Salem, North Carolina

LATINCORR 2000
September 17-22
Cartagena de Indias, Colombia

International Exhibition Brno
September 18-22
Brno, Czech Republic

EUROCOAT
September 19-21
Torino, Italy

Het Instrument Trade Show
October 9-13
Utrecht, The Netherlands

FSCT ICE 2000
October 16-20
McCormick Place
Chicago, Illinois

Cloristic Congress and Exhibition
October 18-20
Pardubice, Czech Republic

ColombiaPlast
October 23-29
Santa Fe de Bogata, Colombia

National Polymer Congress
November 14-17
Mexico

Chemistry 2000
December 1-3
St. Petersburg, Russia

ITME
December 1-10
Mumbai, India

CORRECTION

The E-mail address for Atlas Sales Representative Bill Lucas was misprinted in the last issue. The correct address is:

blucas@atlas-mts.com

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ATTN: Marketing Department

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The MFI2 is now available from stock. Call today to order the MFI2 Melt Flow Indexer (for ASTM D 1238/ ISO 1133 Standard Method B, with or without Weight-Lift option) for shipment within one week, and a 30 day no-risk trial!*

Contact Annette Anderson at 773-327-4520 ext. 234 for more information or to order.

*Some restrictions may apply.

ATLAS
MATERIAL TESTING SOLUTIONS

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